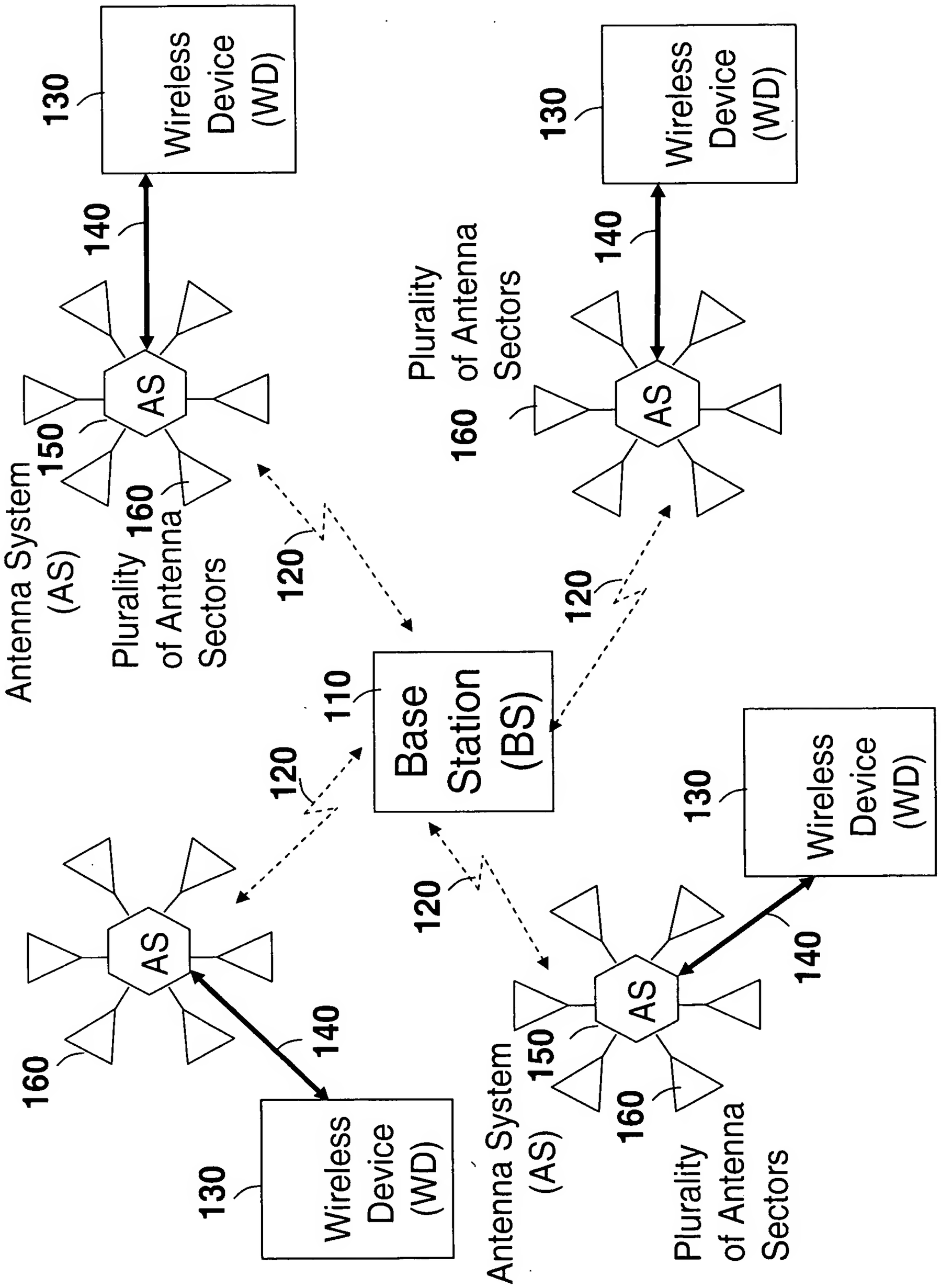

130
Wireless Device (WD)
140
150
AS
Antenna System (AS)
160
Plurality of Antenna Sectors
120
110
Base Station (BS)

Fig. 1

Fig. 2

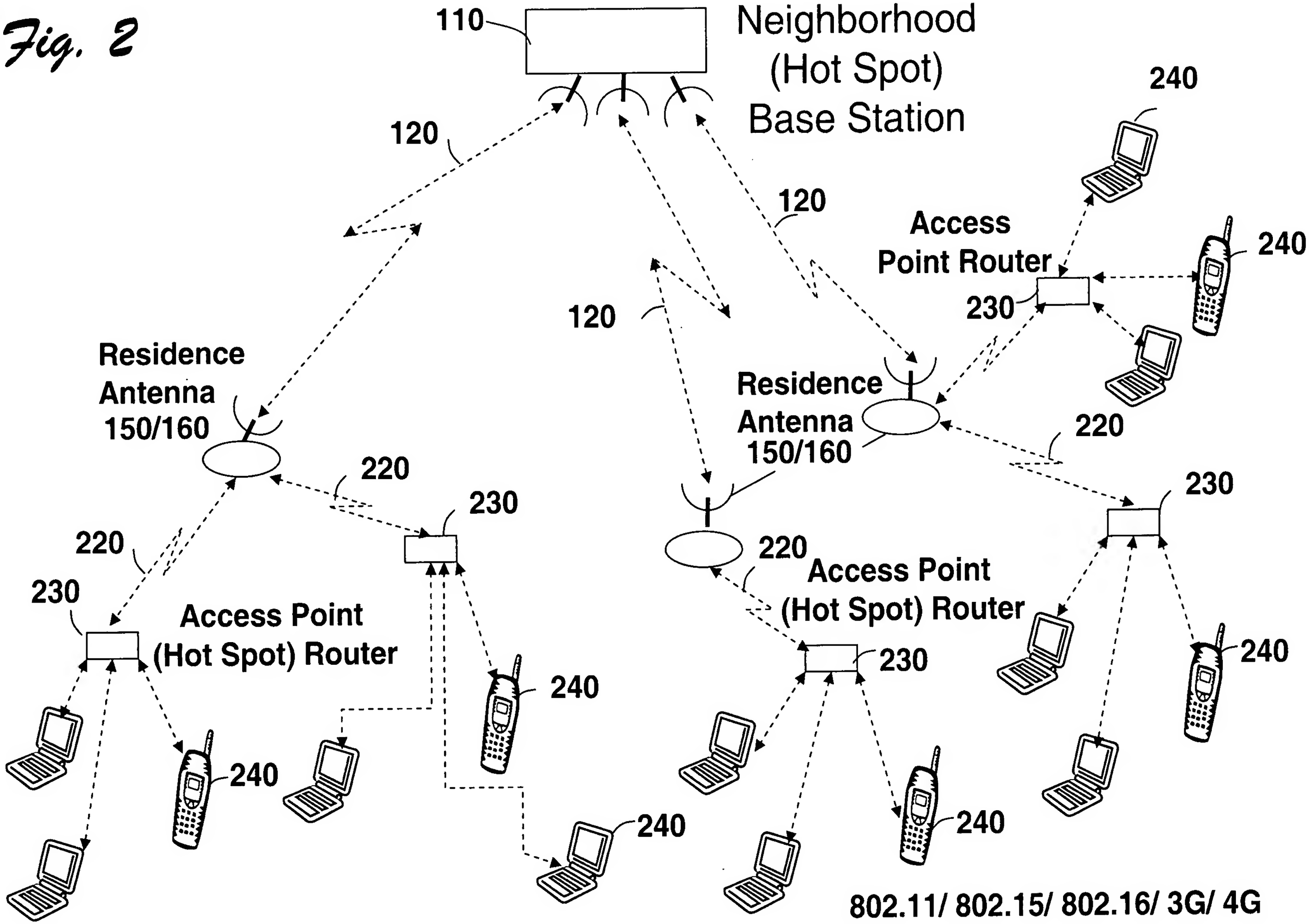
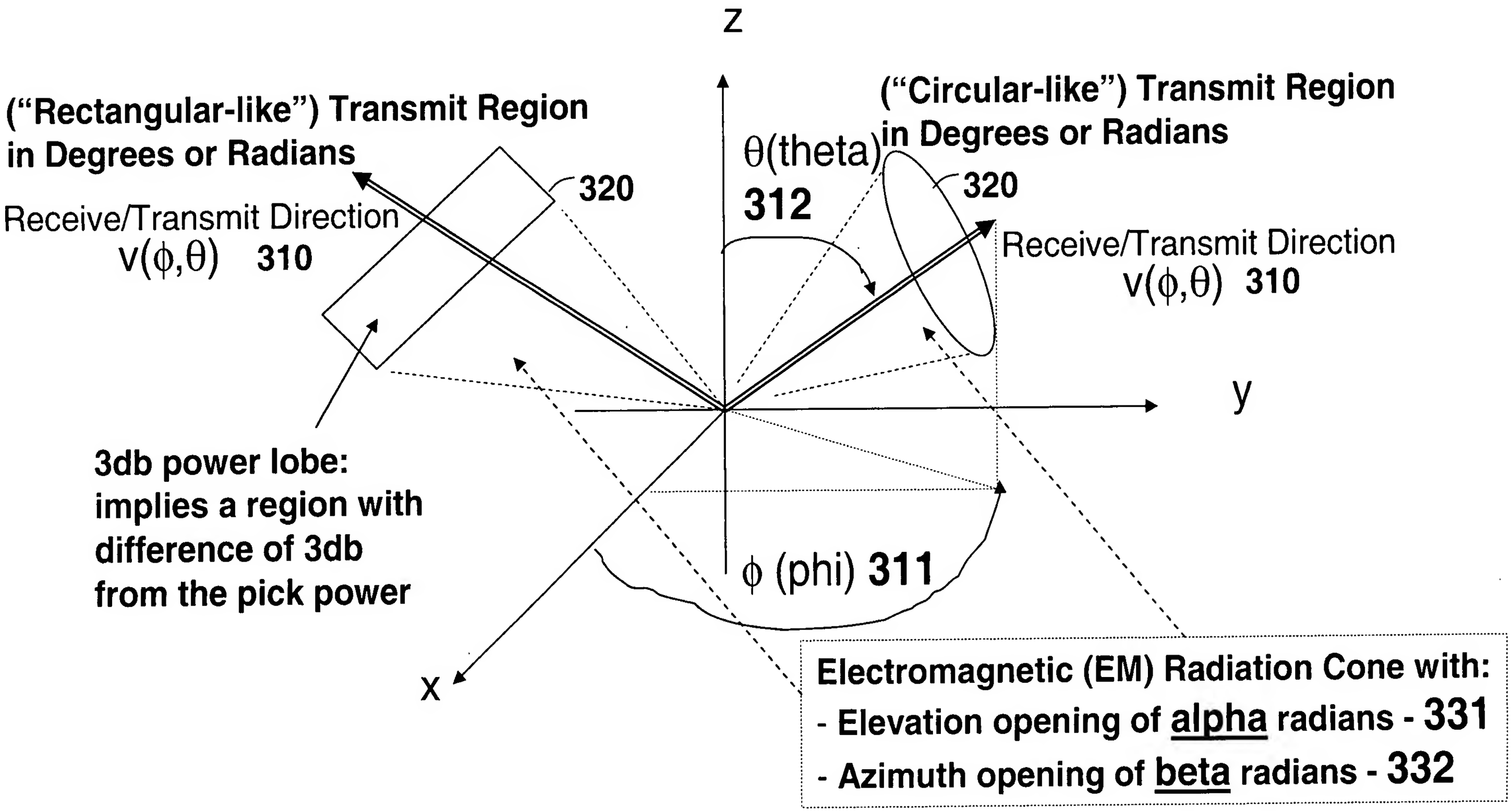

110
Neighborhood
(Hot Spot)
Base Station
120
120
120
240
Access
Point Router
230
240
Residence
Antenna
150/160
220
230
220
230
Access Point
(Hot Spot) Router
240
240
Residence
Antenna
150/160
220
230
220
Access Point
(Hot Spot) Router
230
240
240
802.11/ 802.15/ 802.16/ 3G/ 4G

Fig. 3

Each Antenna Sector **160** is Defined by:

1. Receive/Transmit **Direction** in 3D (Three Dimensional) Space, and
2. Receive/Transmit **Region**
   (the region perpendicular to the Receive/Transmits Direction in a defined distance)



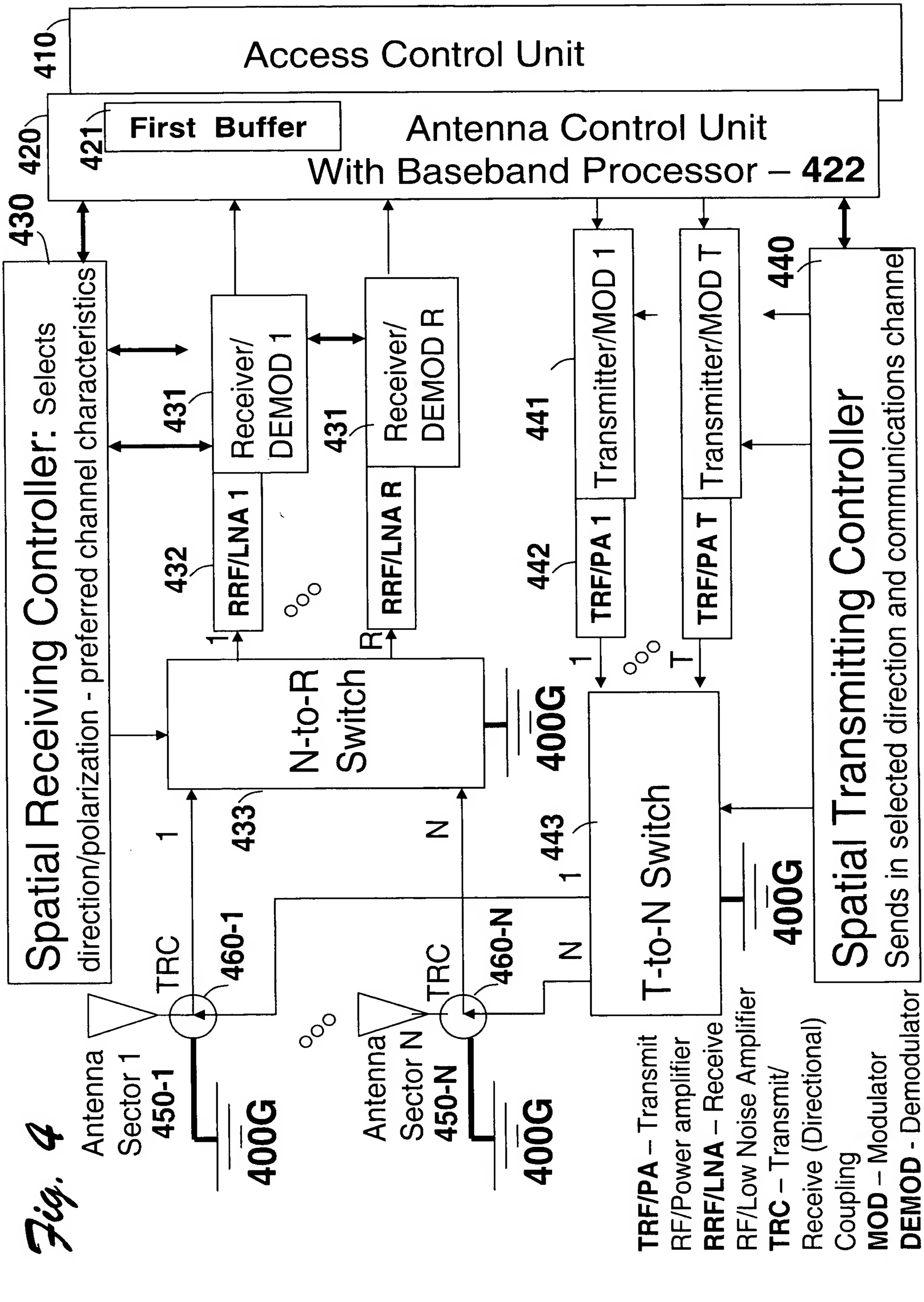

410
Access Control Unit
420
421
First Buffer
Antenna Control Unit
With Baseband Processor – 422
430
Spatial Receiving Controller: Selects direction/polarization - preferred channel characteristics
N-to-R Switch
1
R
431
Receiver/ DEMOD 1
Receiver/ DEMOD R
432
RRF/LNA 1
RRF/LNA R
400G
433
440
Spatial Transmitting Controller
Sends in selected direction and communications channel
441
Transmitter/MOD 1
Transmitter/MOD T
442
TRF/PA 1
TRF/PA T
443
T-to-N Switch
1
N
T
TRC
460-1
460-N
Antenna Sector 1
450-1
Antenna Sector N
450-N
TRF/PA – Transmit RF/Power amplifier
RRF/LNA – Receive RF/Low Noise Amplifier
TRC – Transmit/ Receive (Directional) Coupling
MOD – Modulator
DEMOD - Demodulator

Fig. 4

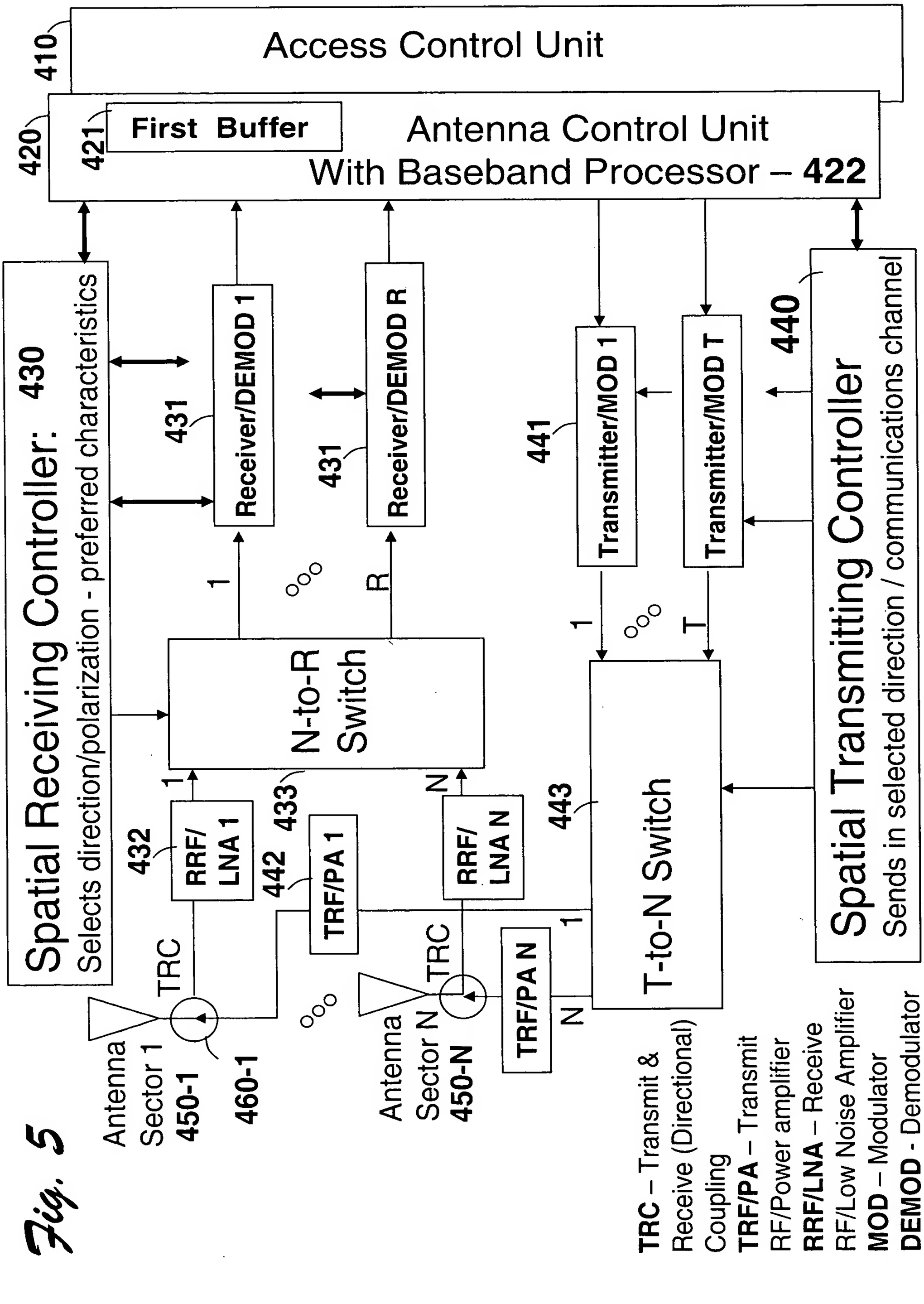
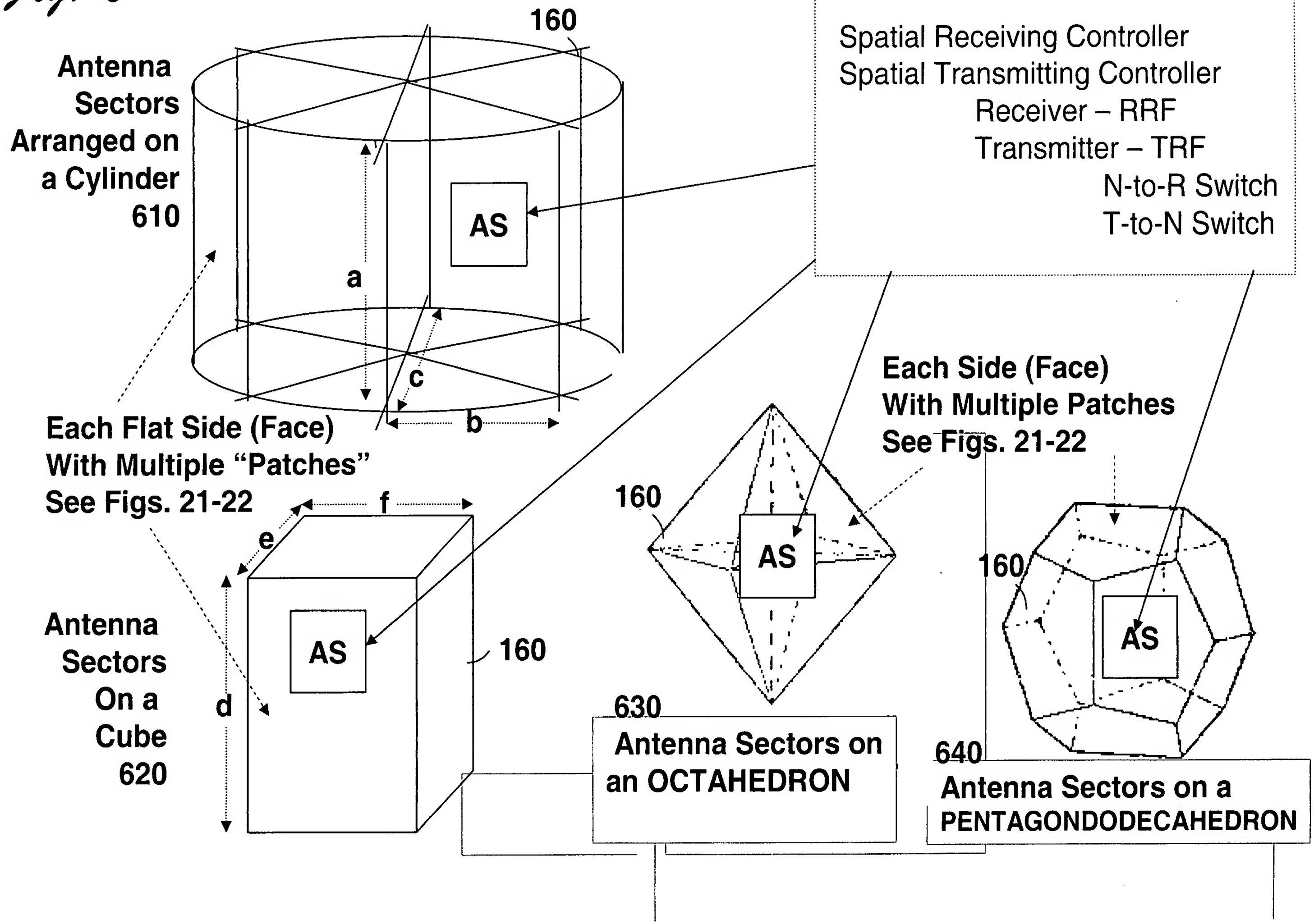

Access Control Unit
410
First Buffer
421
Antenna Control Unit
With Baseband Processor – 422
420
Spatial Receiving Controller: 430
Selects direction/polarization - preferred characteristics
Receiver/DEMOD 1
Receiver/DEMOD R
431
431
1
R
N-to-R Switch
Transmitter/MOD 1
Transmitter/MOD T
441
1
T
440
Spatial Transmitting Controller
Sends in selected direction / communications channel
T-to-N Switch
443
1
N
RRF/ LNA 1
RRF/ LNA N
432
433
1
N
TRF/PA 1
TRF/PA N
442
TRC
TRC
Antenna Sector 1
450-1
460-1
Antenna Sector N
450-N
TRC – Transmit & Receive (Directional) Coupling
TRF/PA – Transmit RF/Power amplifier
RRF/LNA – Receive RF/Low Noise Amplifier
MOD – Modulator
DEMOD - Demodulator

Fig. 5

Fig. 6


Antenna System (AS) - 150
Spatial Receiving Controller
Spatial Transmitting Controller
Receiver – RRF
Transmitter – TRF
N-to-R Switch
T-to-N Switch
Antenna Sectors Arranged on a Cylinder 610
160
AS
a
b
c
Each Flat Side (Face) With Multiple "Patches" See Figs. 21-22
Each Side (Face) With Multiple Patches See Figs. 21-22
Antenna Sectors On a Cube 620
d
e
f
160
AS
160
AS
630
Antenna Sectors on an OCTAHEDRON
160
AS
640
Antenna Sectors on a PENTAGONDODECAHEDRON

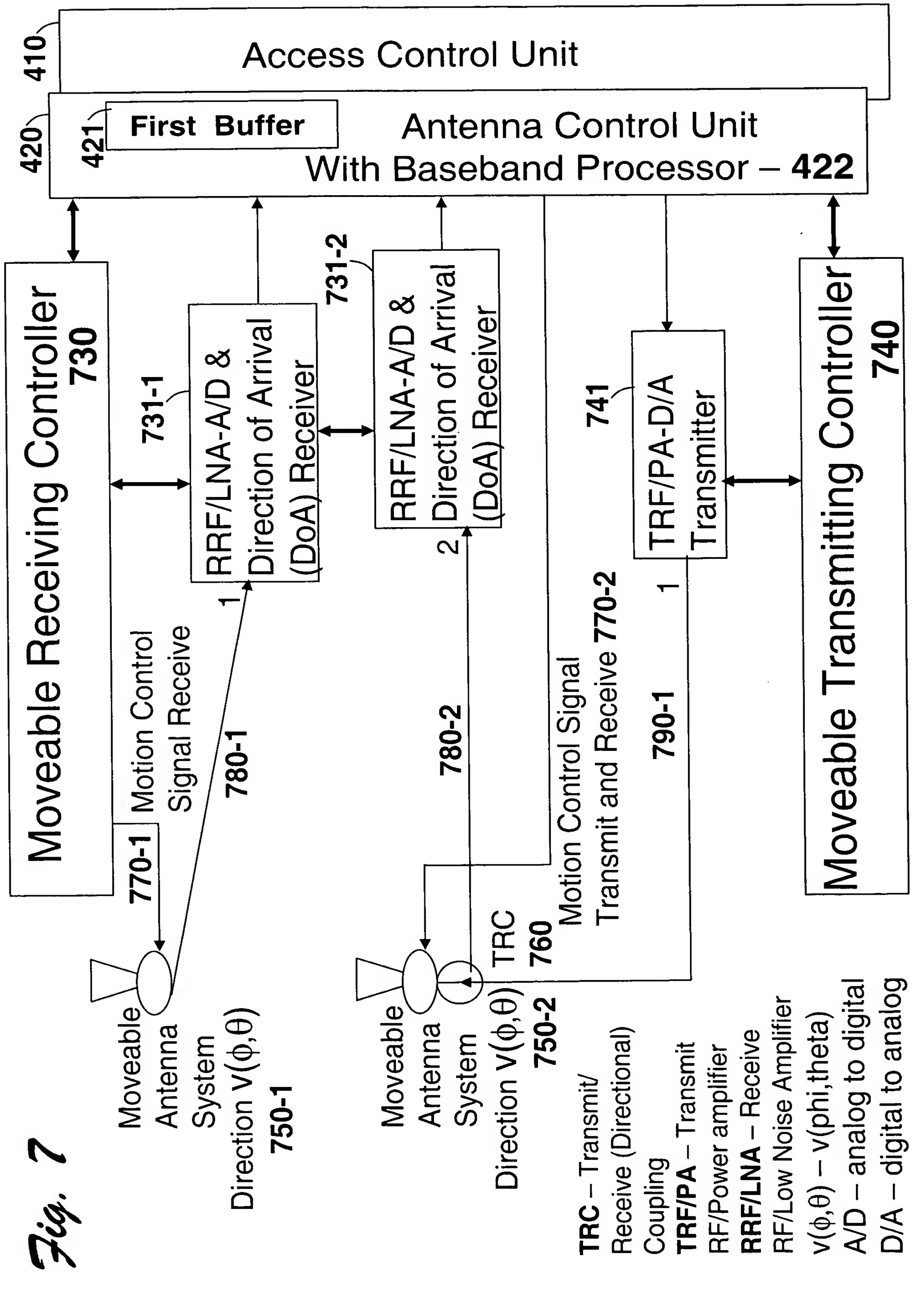
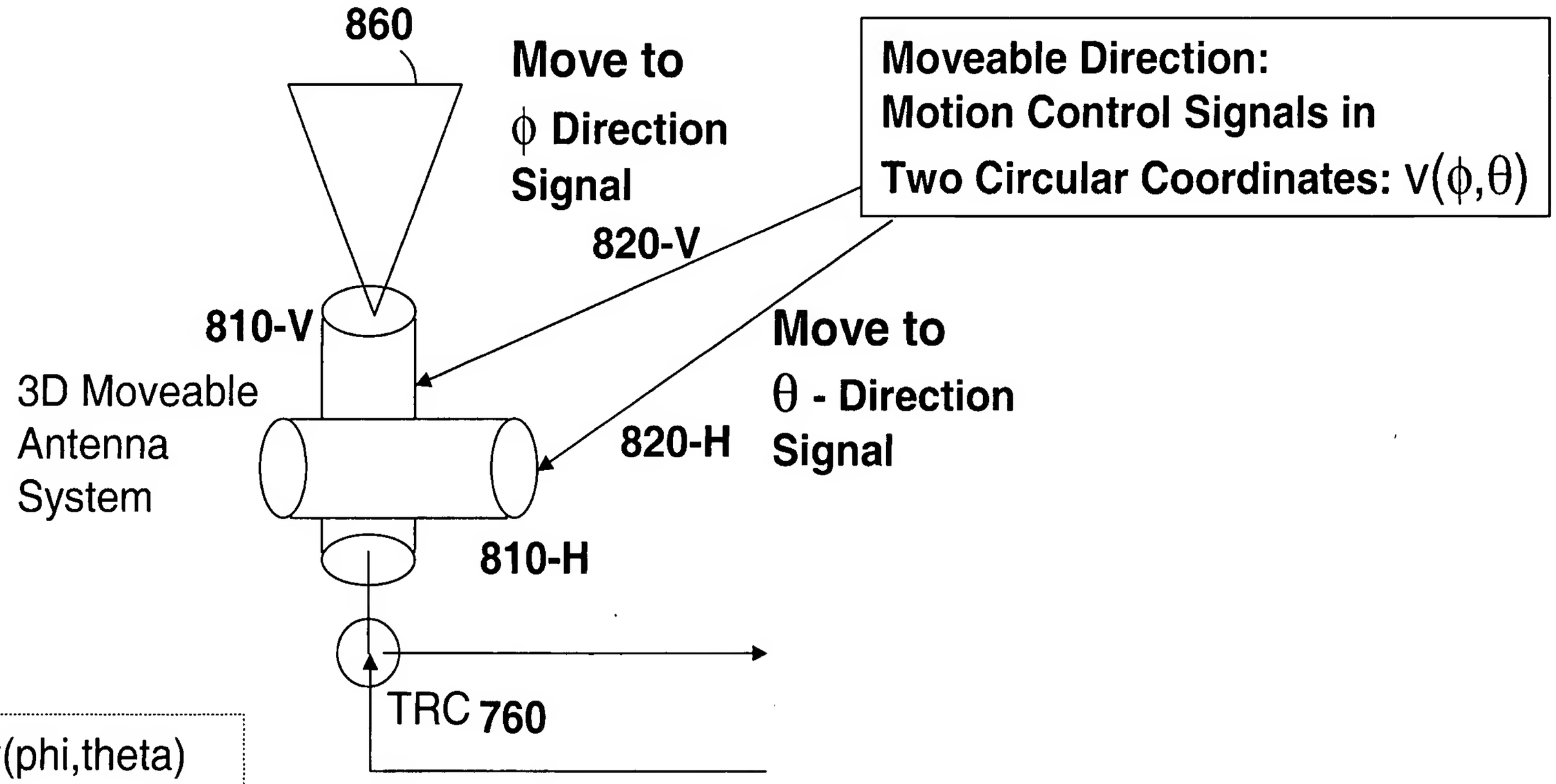

410
Access Control Unit
420
421
First Buffer
Antenna Control Unit
With Baseband Processor – 422
730
Moveable Receiving Controller
770-1
Motion Control
Signal Receive
731-1
RRF/LNA-A/D &
Direction of Arrival
(DoA) Receiver
731-2
RRF/LNA-A/D &
Direction of Arrival
(DoA) Receiver
740
Moveable Transmitting Controller
741
TRF/PA-D/A
Transmitter
770-2
Motion Control Signal
Transmit and Receive
780-1
780-2
790-1
1
2
Moveable
Antenna
System
Direction V(ϕ,θ)
750-1
750-2
TRC
760
TRC – Transmit/
Receive (Directional)
Coupling
TRF/PA – Transmit
RF/Power amplifier
RRF/LNA – Receive
RF/Low Noise Amplifier
v(ϕ,θ) – v(phi,theta)
A/D – analog to digital
D/A – digital to analog

Fig. 7

Fig. 8

Antenna System (AS) – 750
(step-motor / electric motor / electric field)



v(ϕ,θ) – v(phi,theta)
TRC –
Transmit/
Receive (Directional)
Coupling

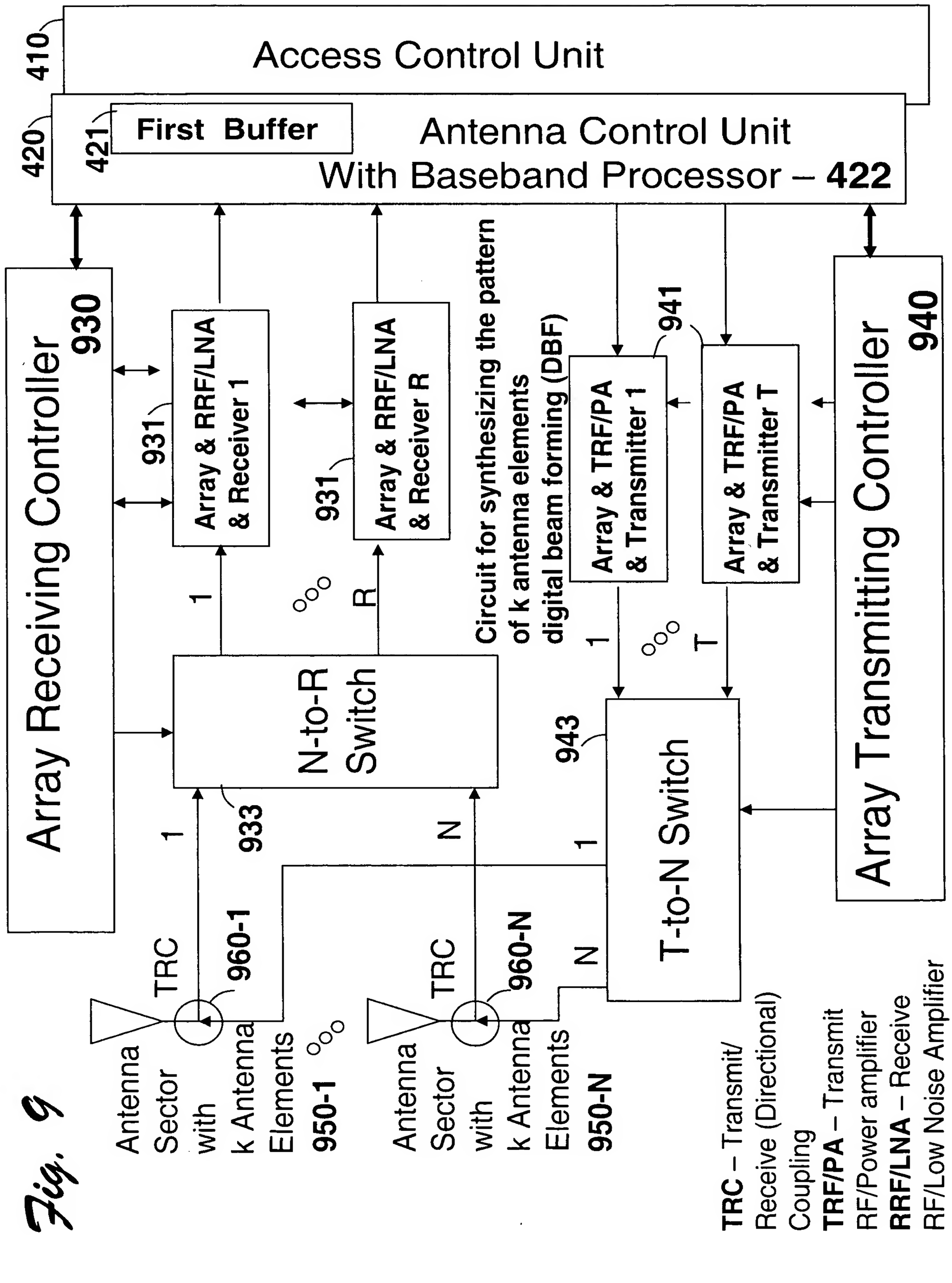

410
Access Control Unit
420
421
First Buffer
Antenna Control Unit
With Baseband Processor – 422
930
Array Receiving Controller
931
Array & RRF/LNA
& Receiver 1
931
Array & RRF/LNA
& Receiver R
1
R
N-to-R
Switch
933
1
N
Circuit for synthesizing the pattern
of k antenna elements
digital beam forming (DBF)
941
Array & TRF/PA
& Transmitter 1
Array & TRF/PA
& Transmitter T
1
T
943
T-to-N Switch
940
Array Transmitting Controller
Antenna
Sector
with
k Antenna
Elements
950-1
TRC
960-1
Antenna
Sector
with
k Antenna
Elements
950-N
TRC
960-N
TRC – Transmit/
Receive (Directional)
Coupling
TRF/PA – Transmit
RF/Power amplifier
RRF/LNA – Receive
RF/Low Noise Amplifier

Fig. 9

Fig. 10

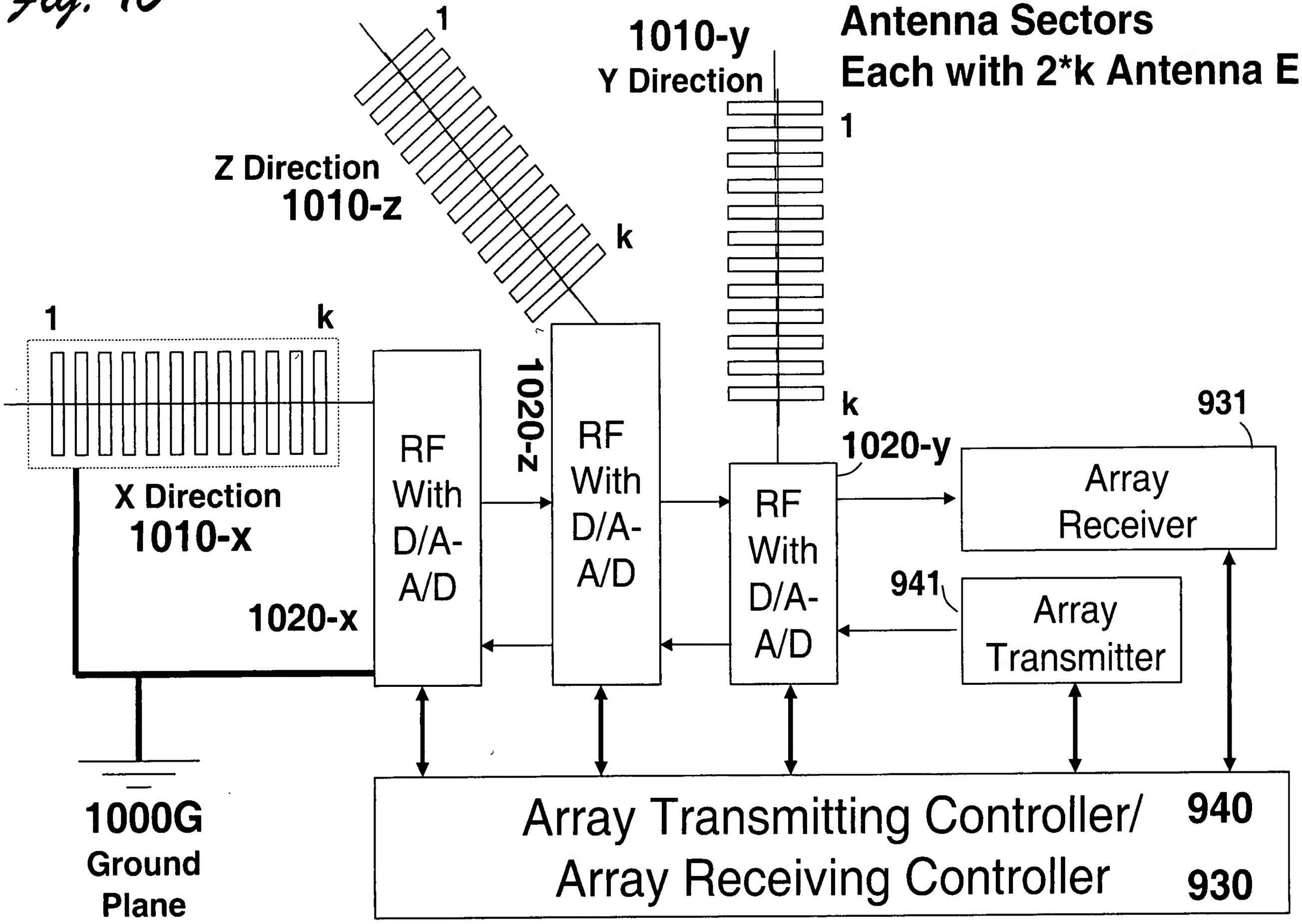


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Fig. 11

Access Control Unit - 410

Send Data Packet Procedure: 1100

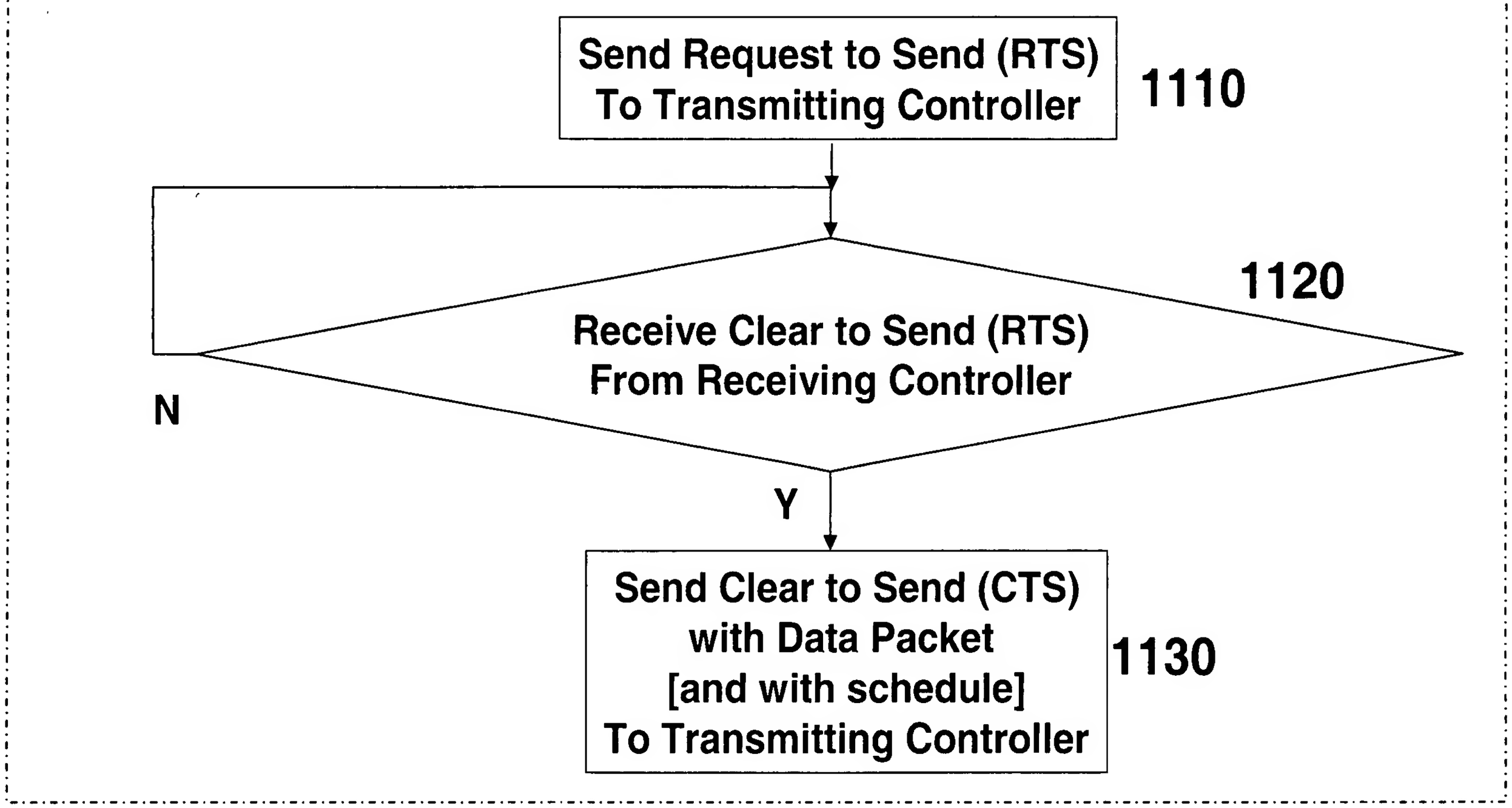


Fig. 12

Antenna Control Unit - 420

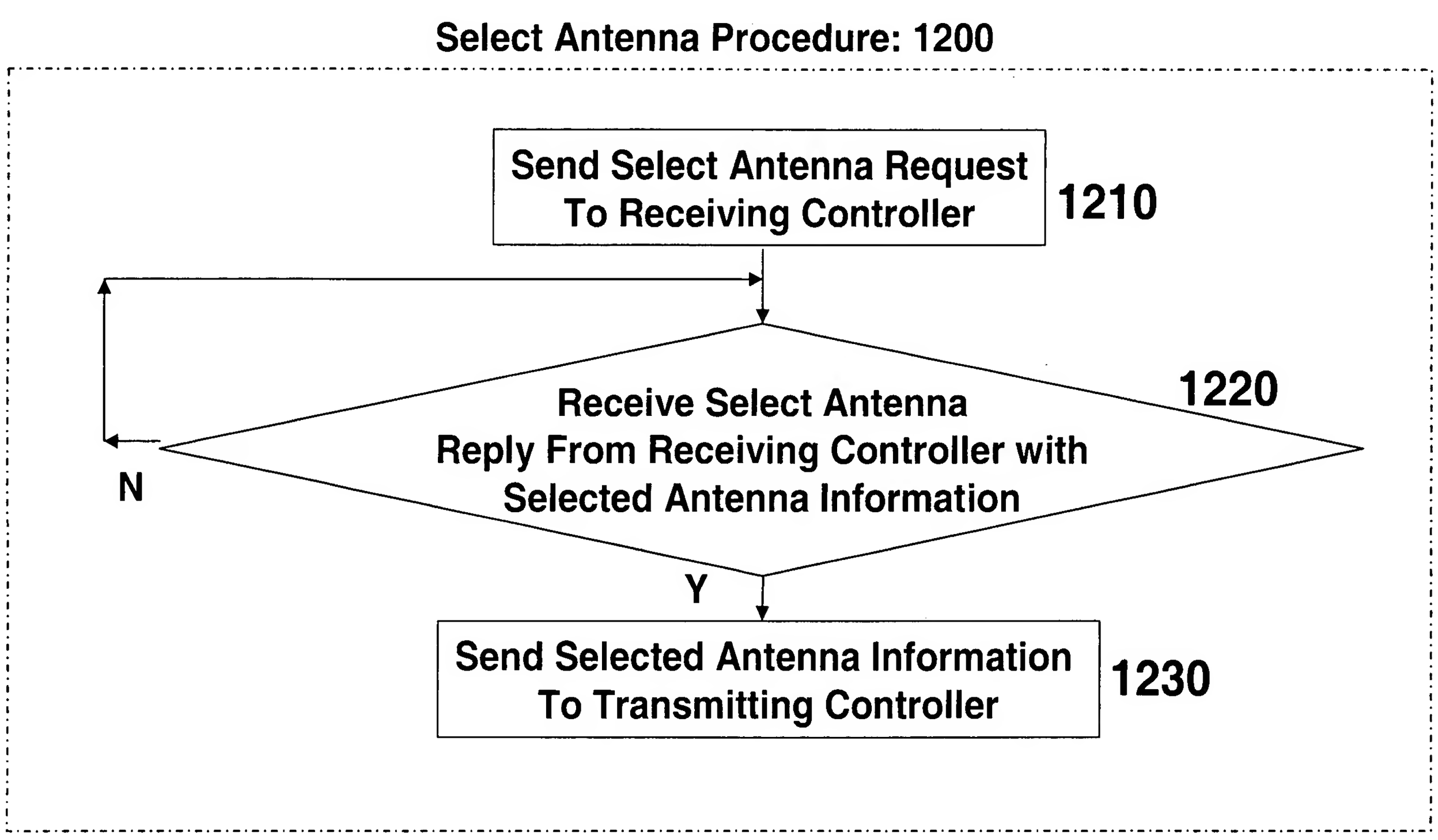


Fig. 13

Spatial Receiving Controller - 430

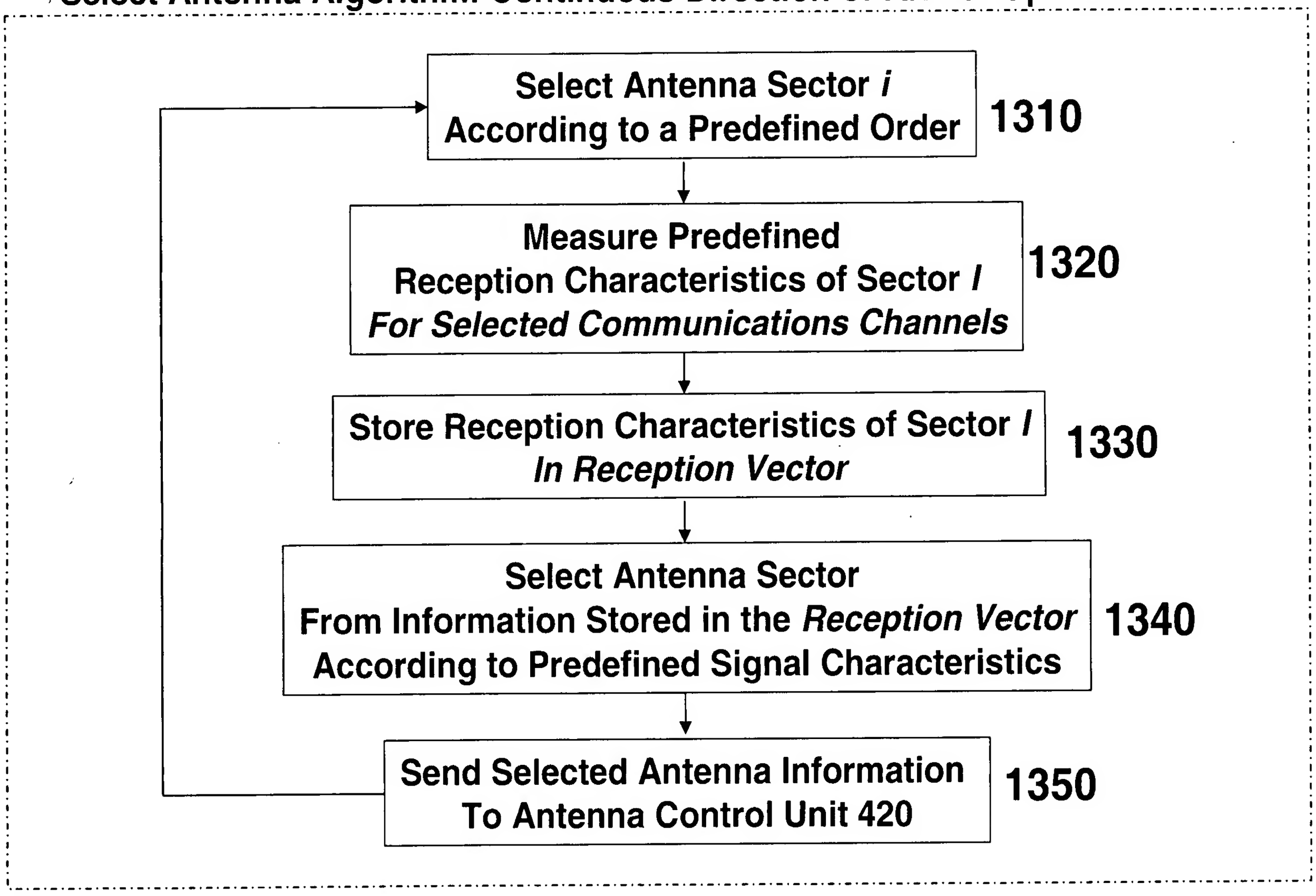


Fig. 14

Spatial Transmitting Controller - 440

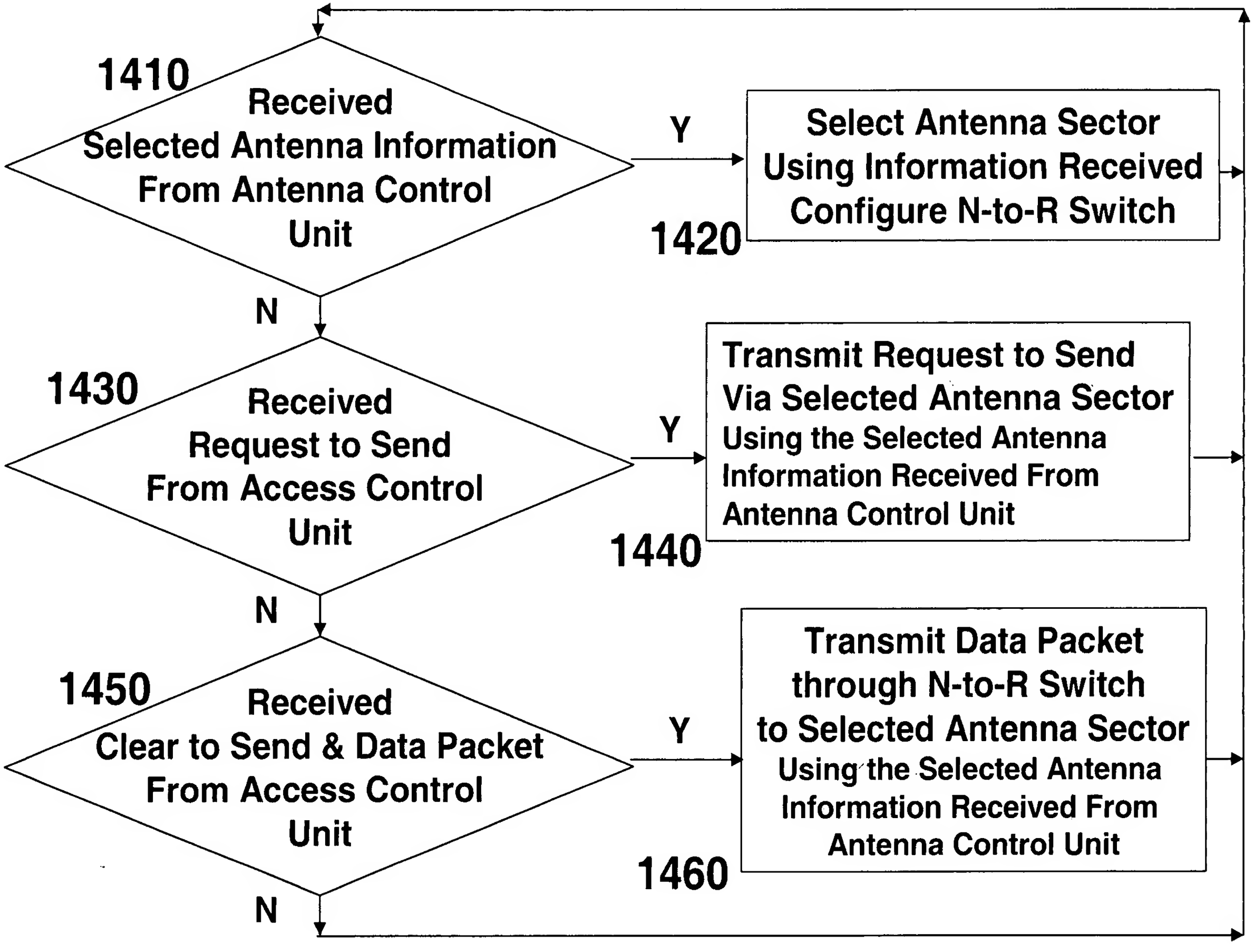
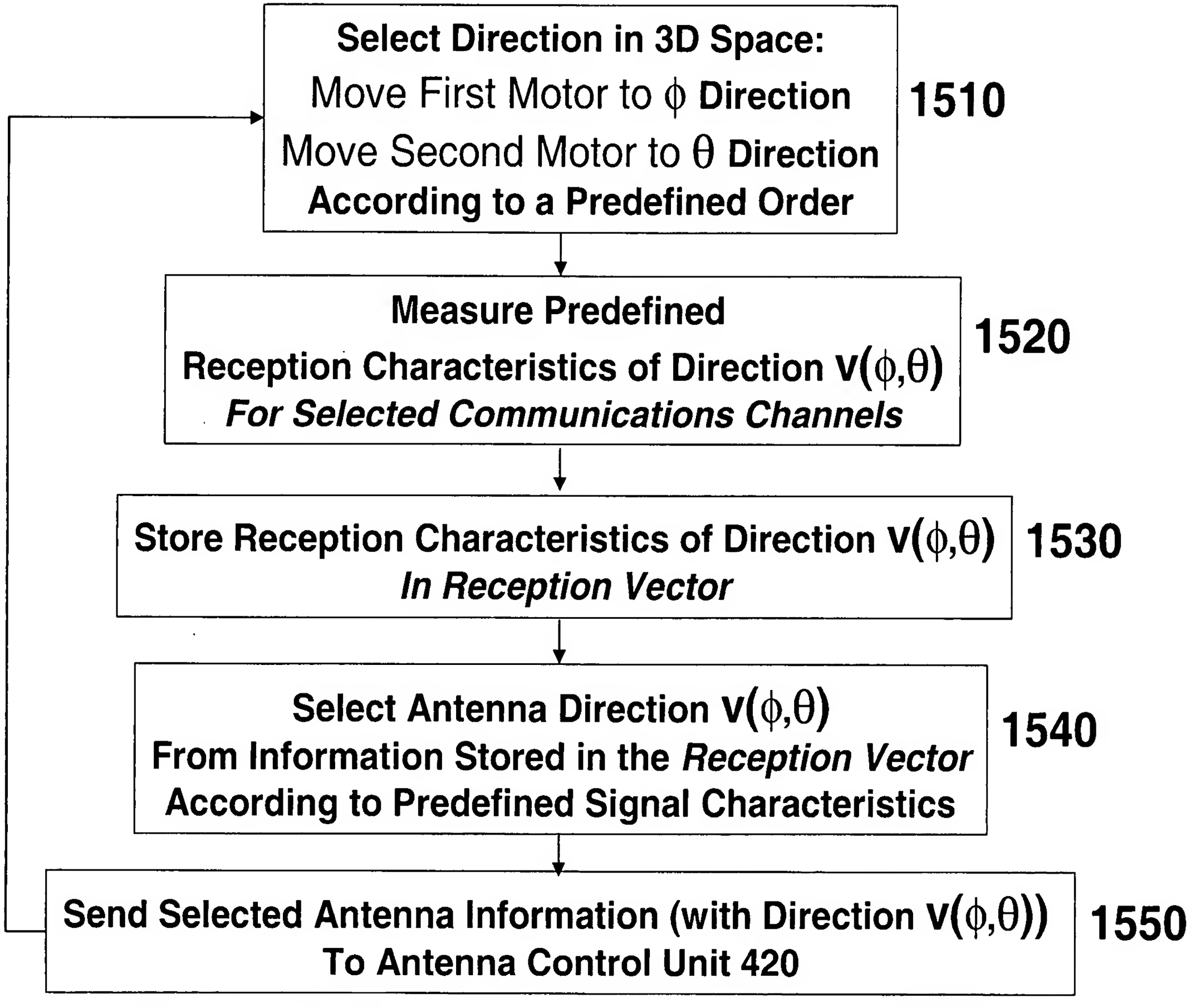


Fig. 15

Moveable Receiving Controller – 730

Select Direction Algorithm: Continuous Direction-of-Arrival Operation 1500



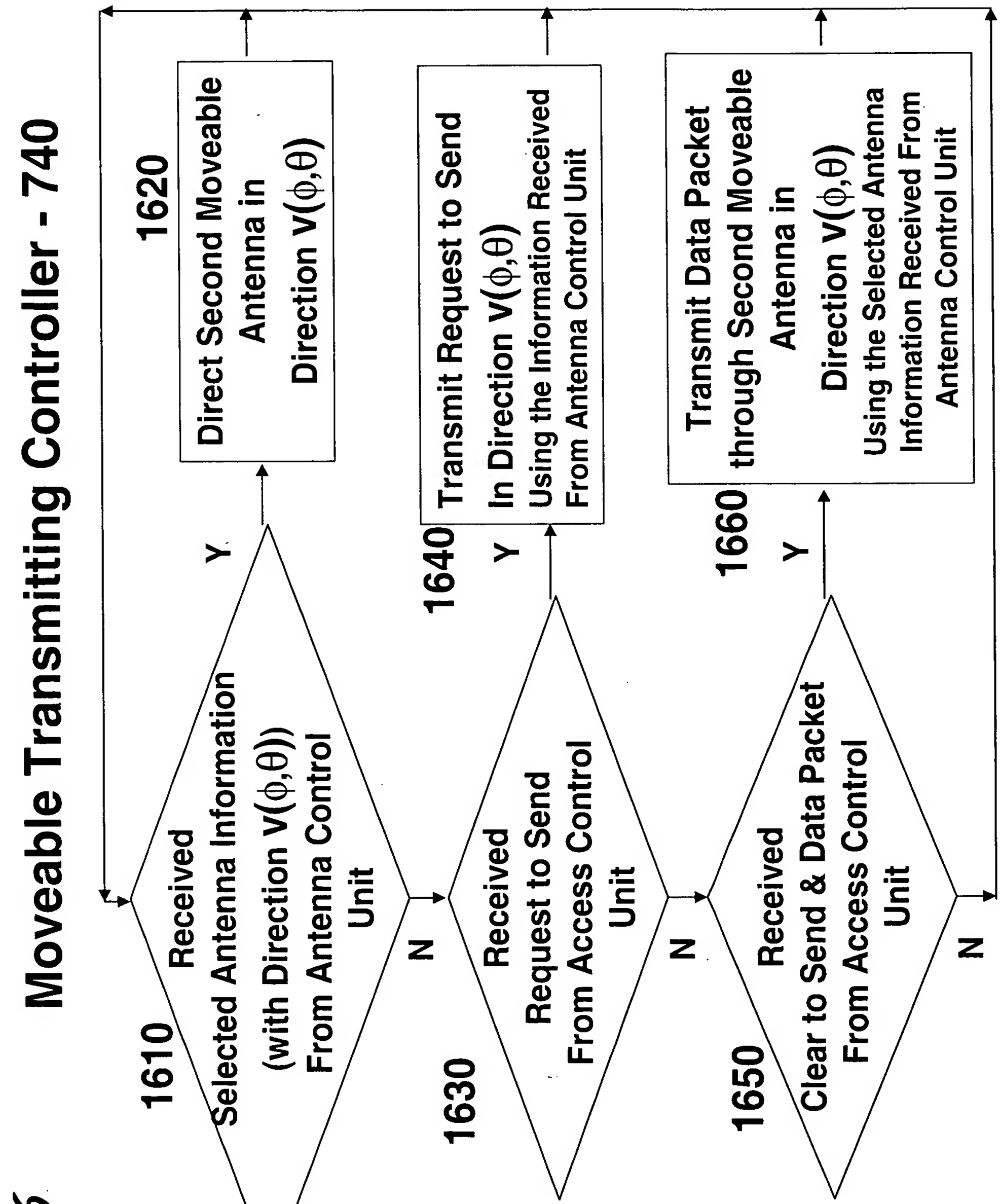
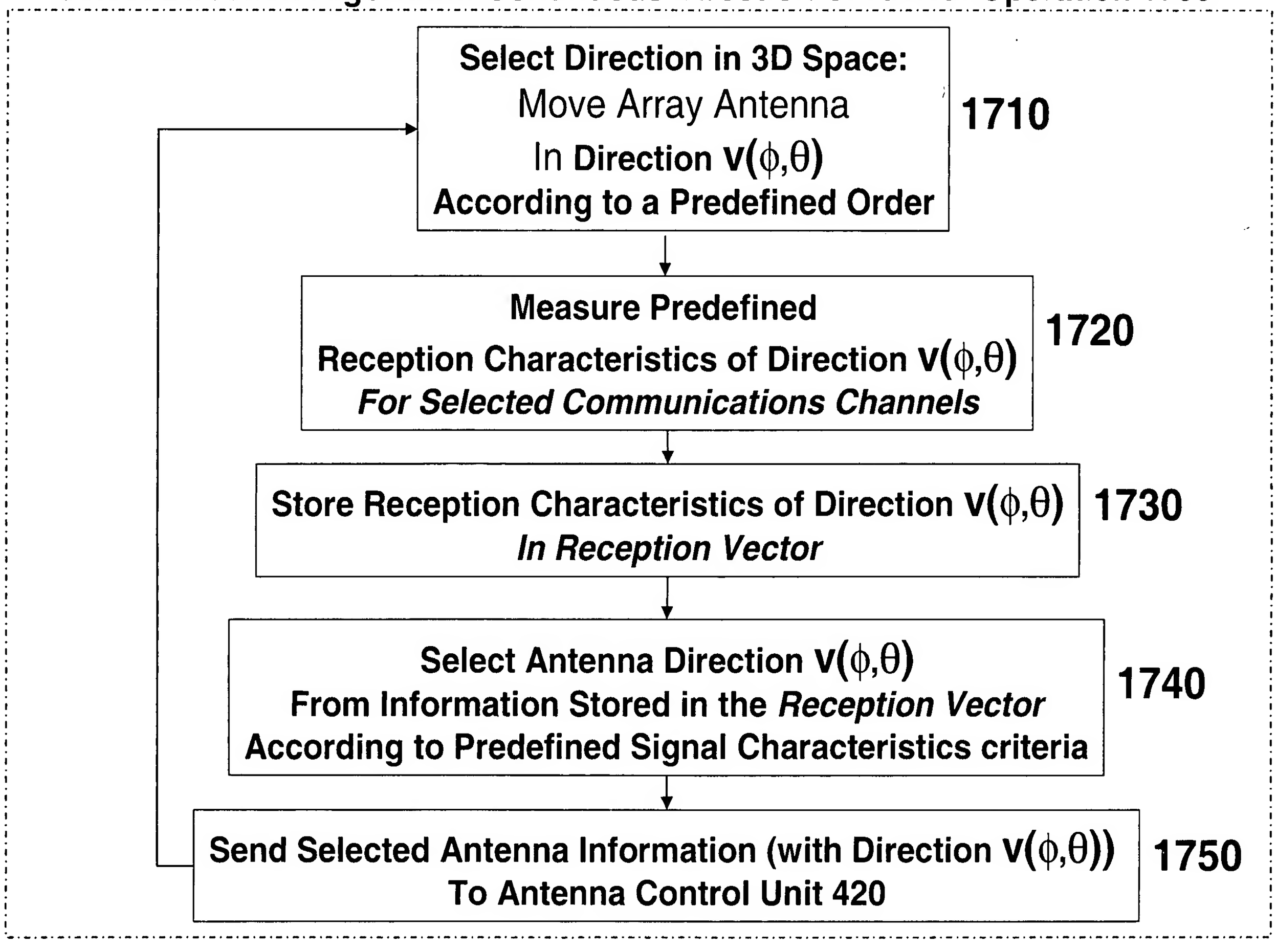

Moveable Transmitting Control - 740
1610
Received Selected Antenna Information (with Direction V(ϕ,θ)) From Antenna Control Unit
Y
1620
Direct Second Moveable Antenna in Direction V(ϕ,θ)
N
1630
Received Request to Send From Access Control Unit
Y
1640
Transmit Request to Send In Direction V(ϕ,θ) Using the Information Received From Antenna Control Unit
N
1650
Received Clear to Send & Data Packet From Access Control Unit
Y
1660
Transmit Data Packet through Second Moveable Antenna in Direction V(ϕ,θ) Using the Selected Antenna Information Received From Antenna Control Unit
N

Fig. 16

Fig. 17

Array Receiving Controller - 930

Select Direction Algorithm: Continuous Direction-of-Arrival Operation 1700



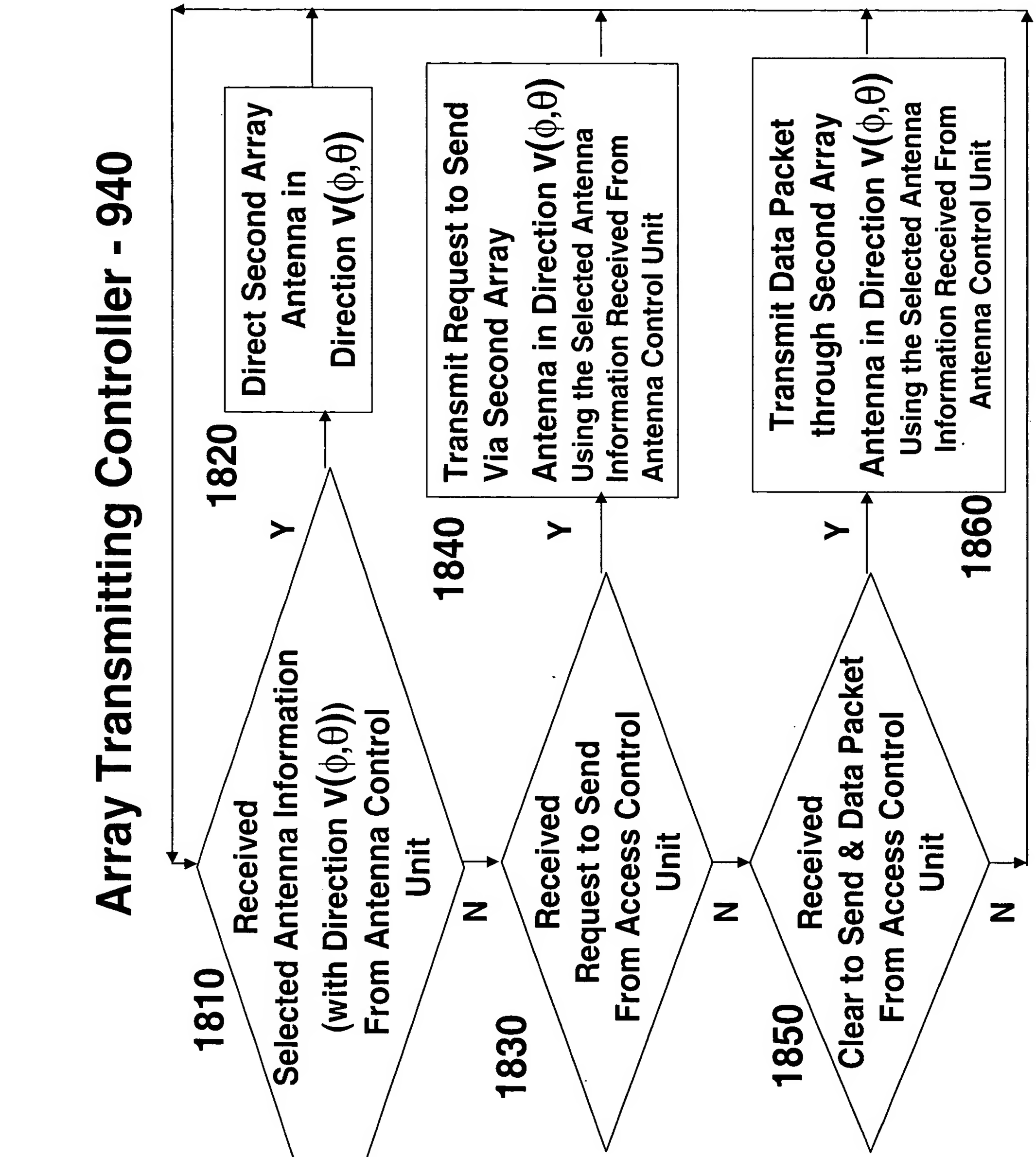

Array Transmitting Controller - 940
1810
Received Selected Antenna Information (with Direction V(ϕ,θ)) From Antenna Control Unit
Y
N
1820
Direct Second Array Antenna in Direction V(ϕ,θ)
1830
Received Request to Send From Access Control Unit
Request to Send Via Second Array Antenna in Direction V(ϕ,θ) Using the Selected Antenna Information Received From Antenna Control Unit
1840
1850
Received Data Packet & Clear to Send From Access Control Unit
Transmit Data Packet through Second Array Antenna in Direction V(ϕ,θ) Using the Selected Antenna Information Received From Antenna Control Unit
1860

Fig. 18

Fig. 19

End (Mobile) Device Transmits and Receives on Different Frequencies – Selecting Transmit Antenna Sector

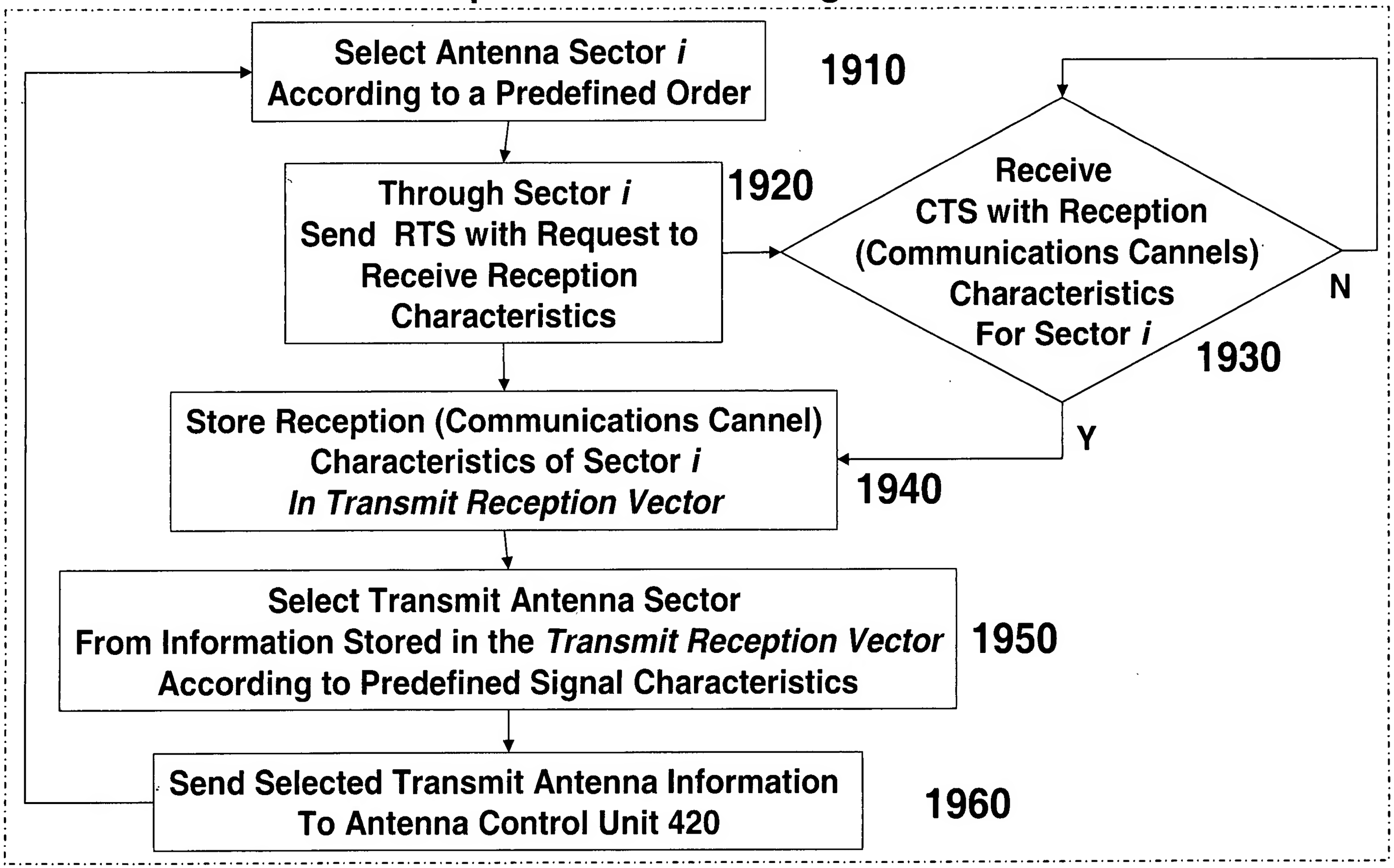
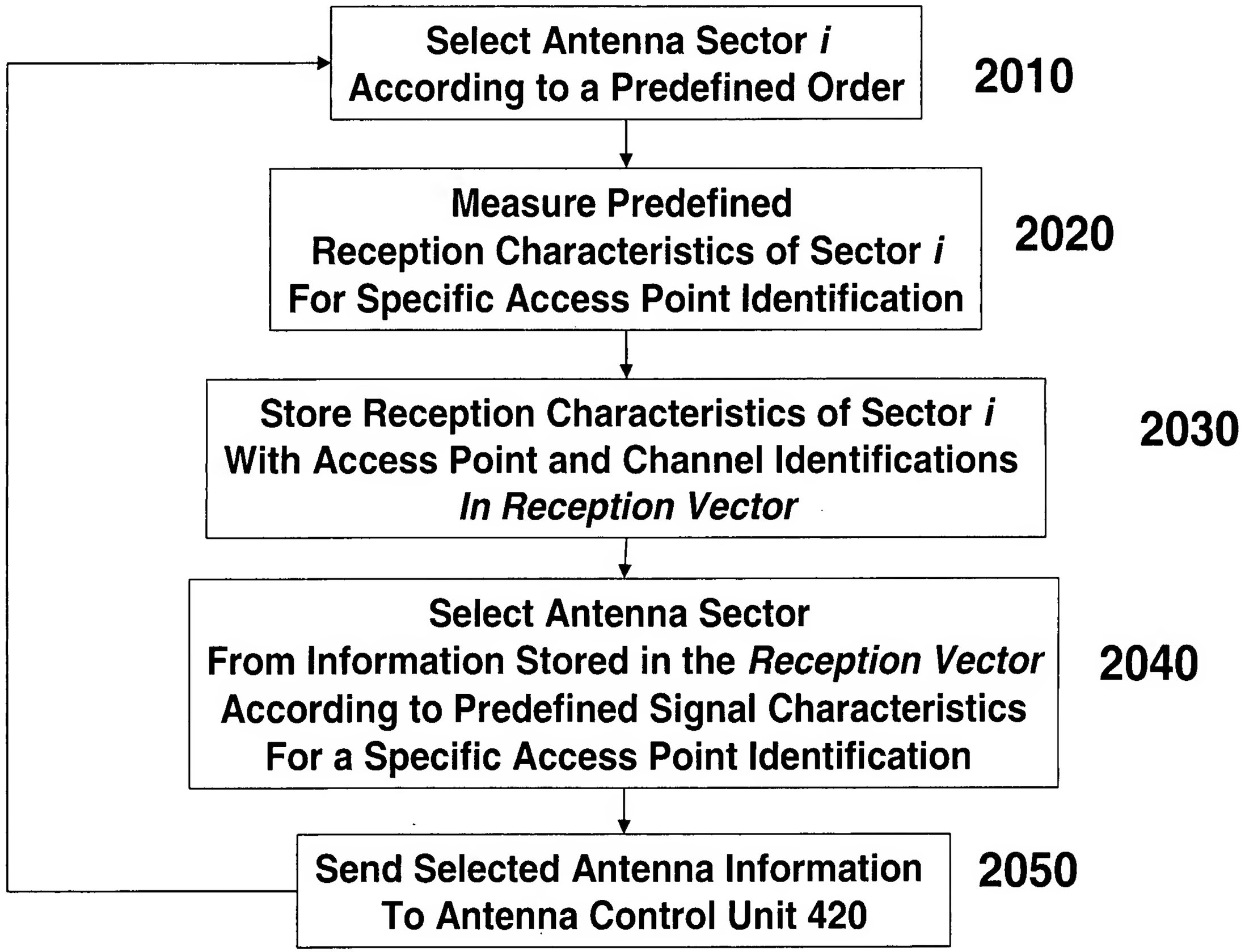


Fig. 20

Mobile Locks on a Specific Access Point Identification



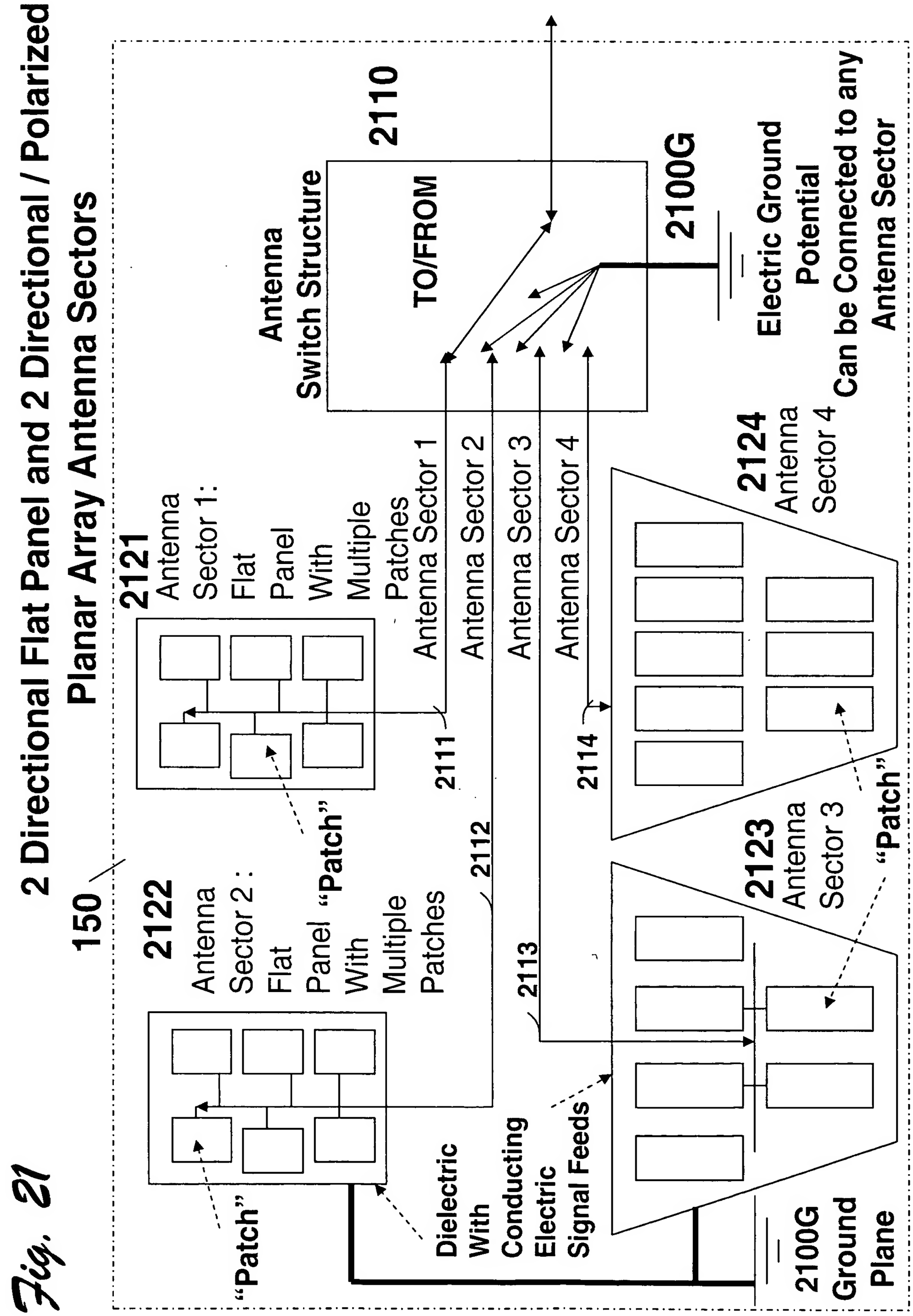


Fig. 21
2 Directional Flat Panel and 2 Directional / Polarized Planar Array Antenna Sectors
150
2110
Antenna Switch Structure
TO/FROM
2100G
Electric Ground Potential
Can be Connected to any Antenna Sector
2121
Antenna Sector 1: Flat Panel With Multiple Patches
2111
Antenna Sector 1
Antenna Sector 2
Antenna Sector 3
Antenna Sector 4
2114
2124
Antenna Sector 4
2122
Antenna Sector 2: Flat Panel With Multiple Patches
2112
2123
Antenna Sector 3
2113
"Patch"
"Patch"
"Patch"
Dielectric With Conducting Electric Signal Feeds
2100G
Ground Plane

Fig. 22

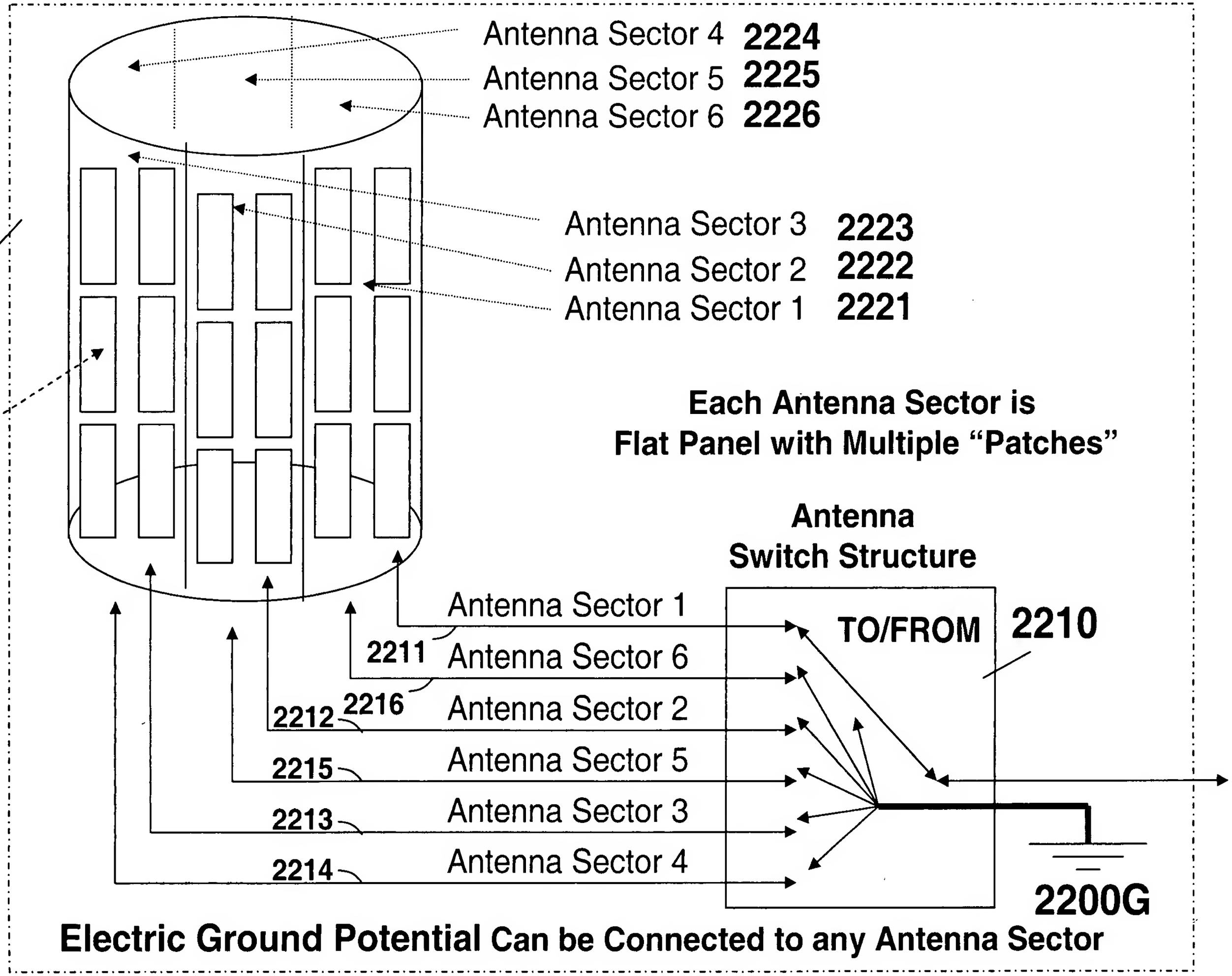
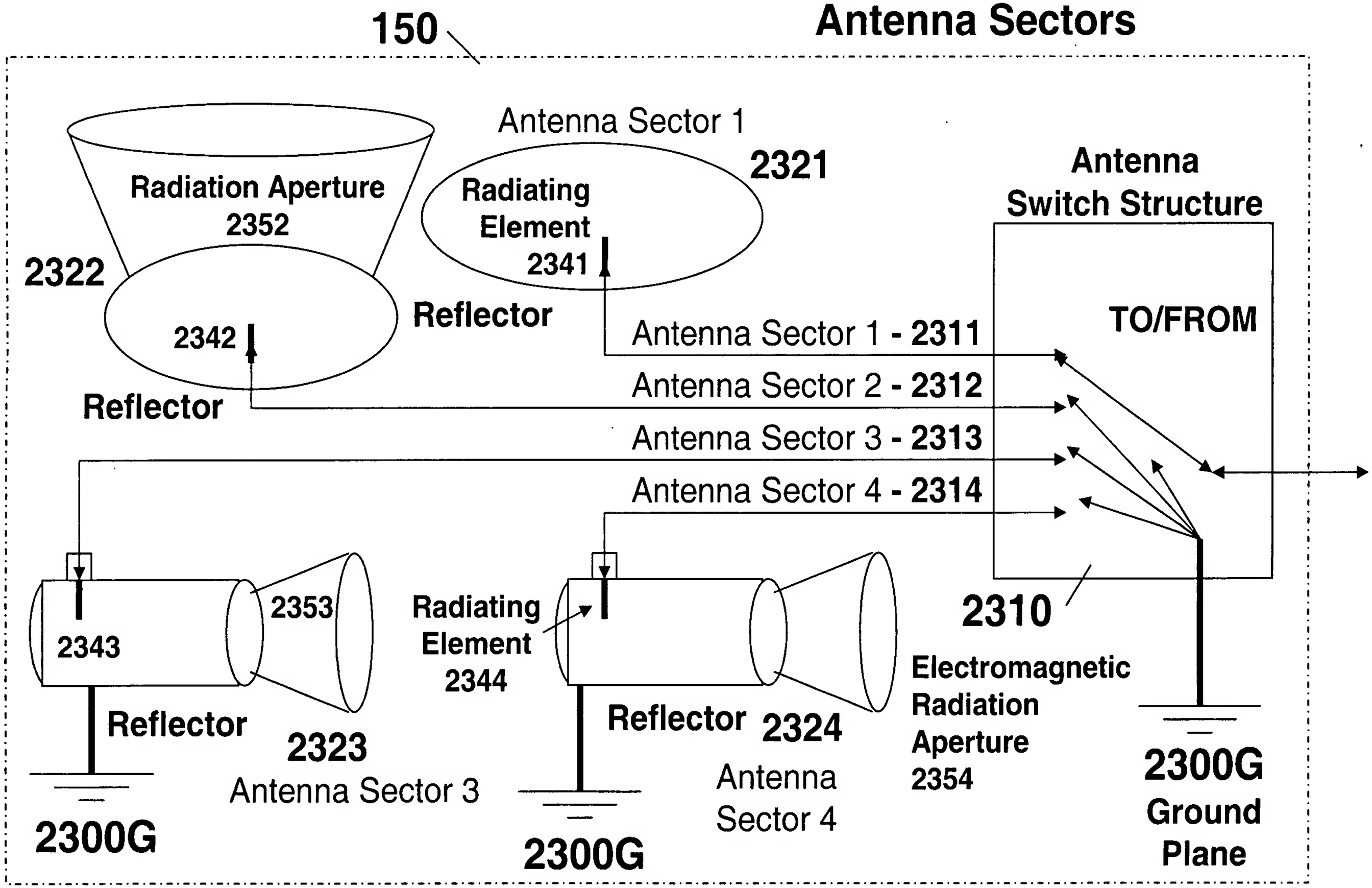
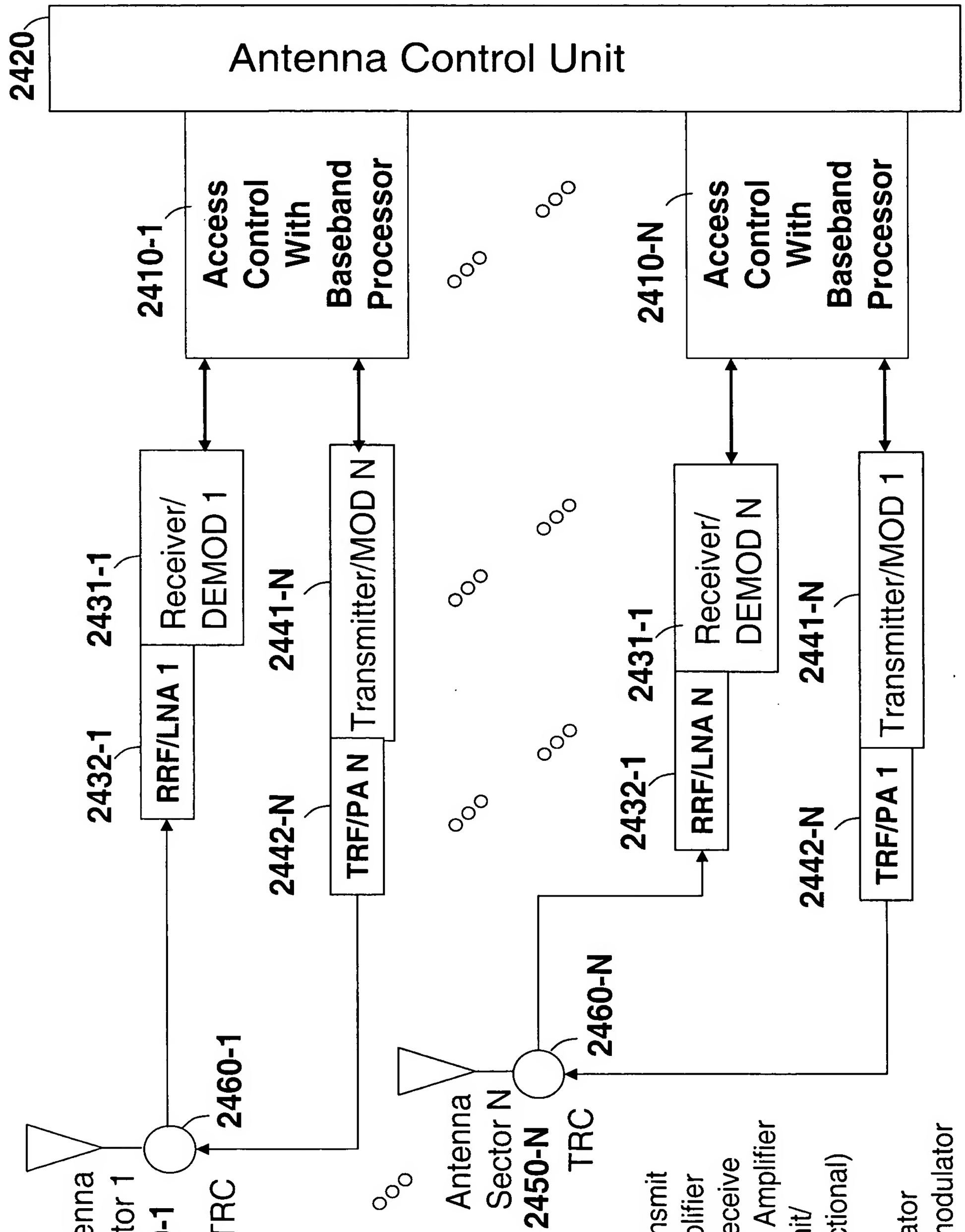

Antenna Sector 4 2224
Antenna Sector 5 2225
Antenna Sector 6 2226
150
Antenna Sector 3 2223
Antenna Sector 2 2222
Antenna Sector 1 2221
"Patch"
Each Antenna Sector is
Flat Panel with Multiple "Patches"
Antenna
Switch Structure
Antenna Sector 1
TO/FROM
2210
2211
Antenna Sector 6
2216
2212
Antenna Sector 2
2215
Antenna Sector 5
2213
Antenna Sector 3
2214
Antenna Sector 4
2200G
Electric Ground Potential Can be Connected to any Antenna Sector

Fig. 23

4 Directional Parabolic-dish-reflector or Yagi/Tube-like Antenna Sectors





TRF/PA – Transmit RF/Power amplifier
RRF/LNA – Receive RF/Low Noise Amplifier
TRC – Transmit/ Receive (Directional) Coupling
MOD – Modulator
DEMOD - Demodulator

Fig. 24

Fig. 25

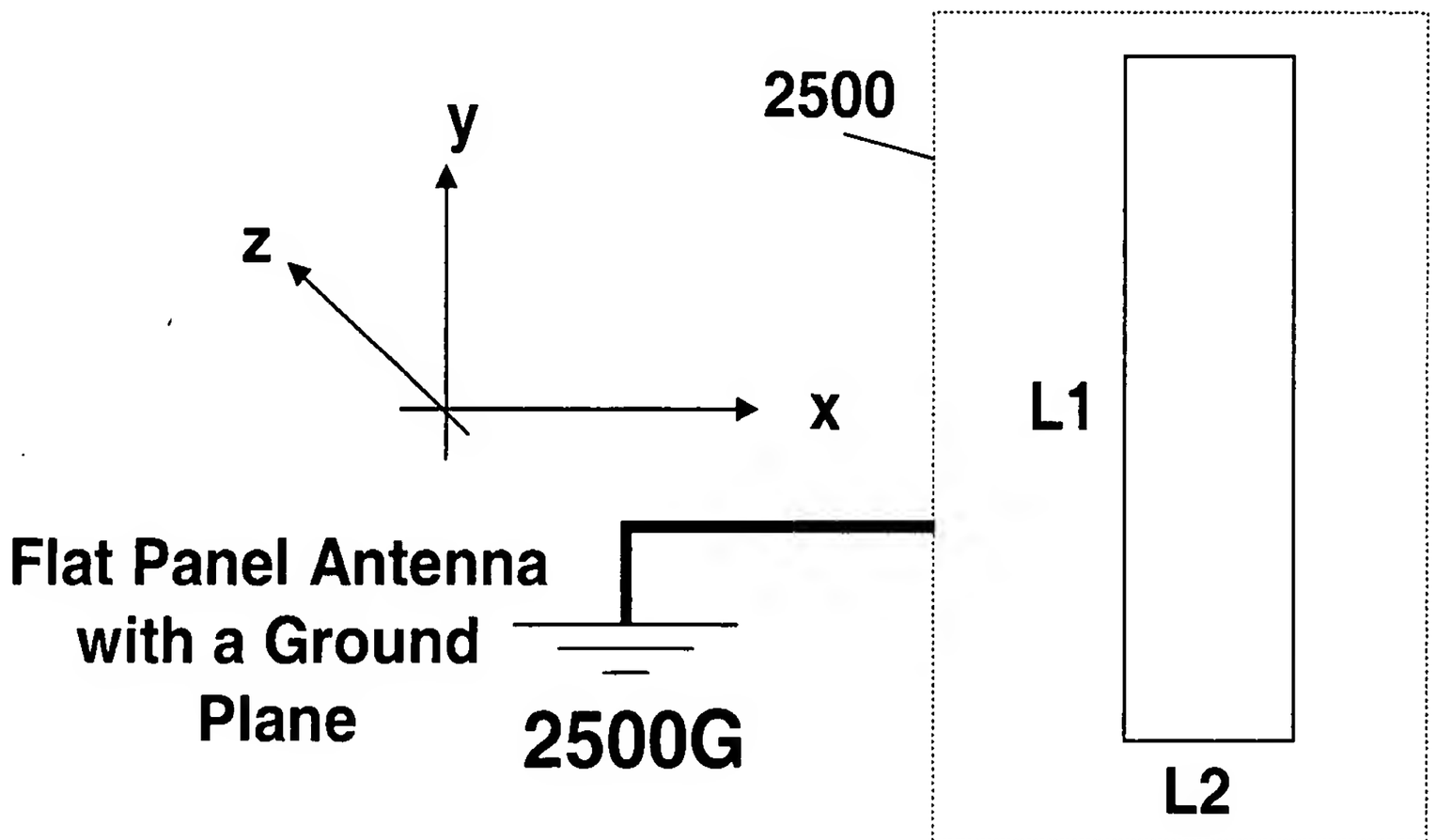
Flat Panel Antenna Sector Design

2511. $g_{max} \approx 4*(3.14)*\{(L1*L2)/(Lambda^2)\}$ **[Lambda = speed-of-light/Frequency]**
[A=L1*L2 is the rectangular area of **antenna aperture** in cm ^{2}]

2512. Lambda/L1 and Lambda/L2 are the beam widths –
in radians (57.3 degrees)

2513. Antenna Gain: $G(db) = 10 \log_{10}(g_{max}) \approx 10 \log_{10} [12.5*A / Lambda^2]$

Aperture



L1-by-L2
Flat Panel Antenna Sector
Wherein:
- **L1 is in the x-y plane**
- **L2 is in the z direction – 90 degree with respect to to the x-y plane**

However:
- **L1 may be tilted in the z direction**
- **L2 may be tilted in a defined angle with respect to the x-y plane**

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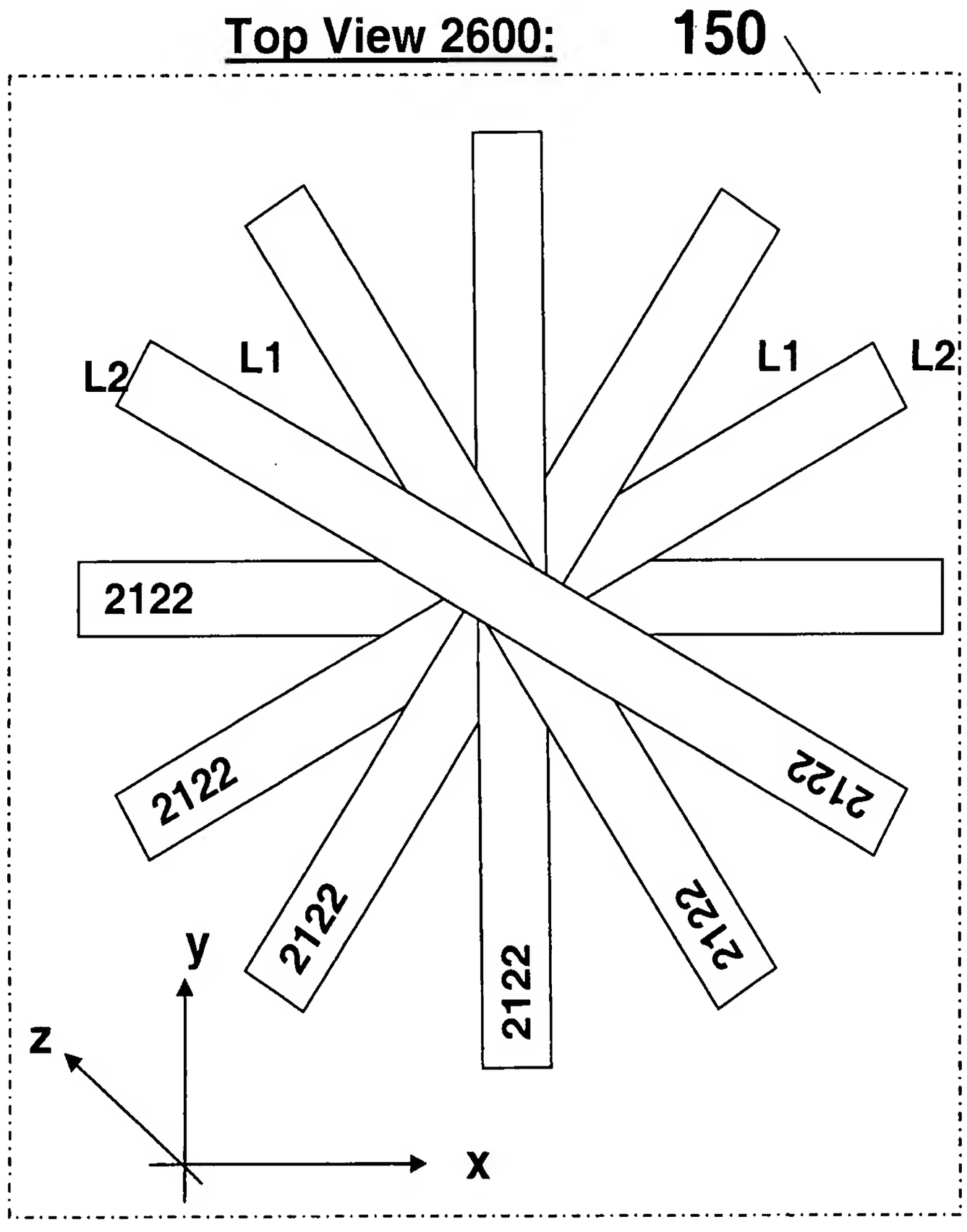
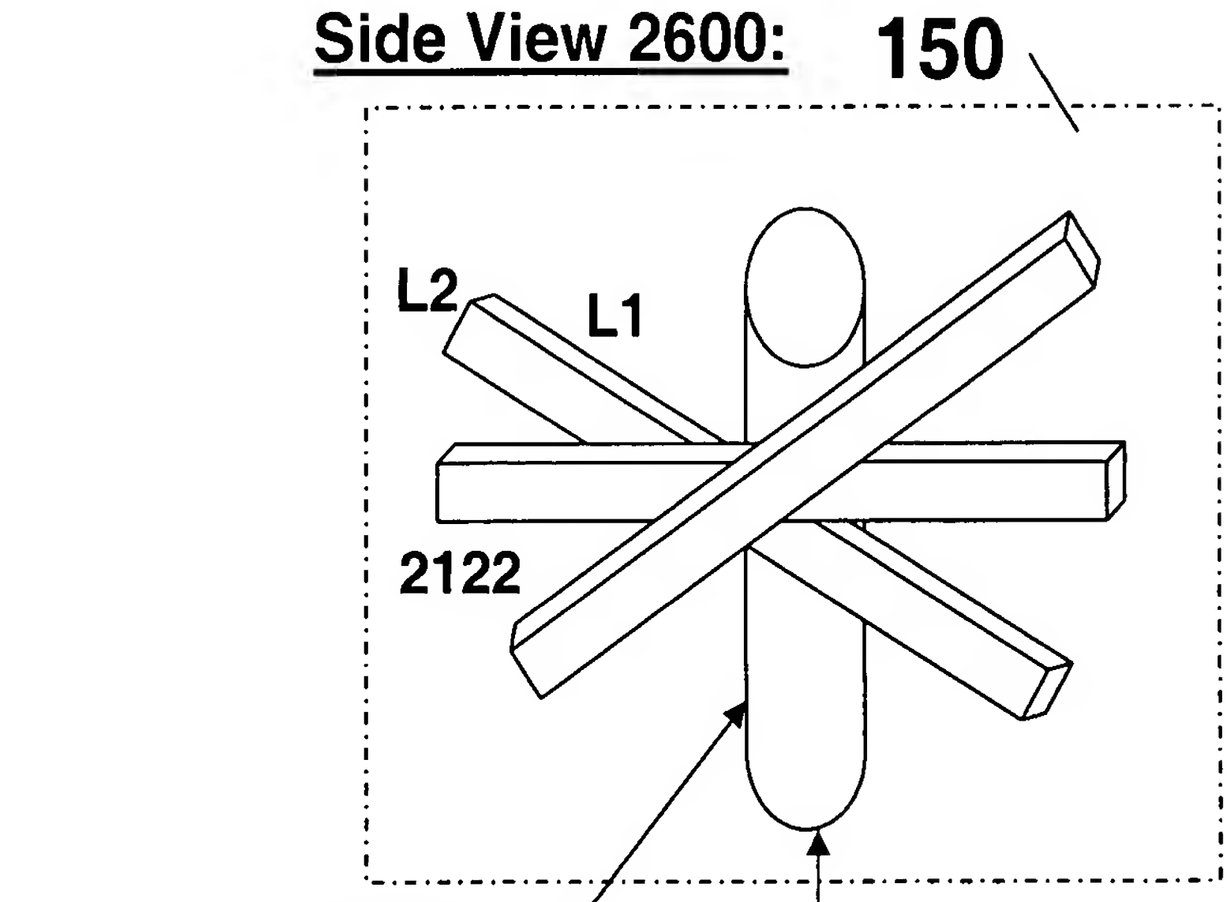
Fig. 26

Plurality of Vertically Stackable Flat Panel Antenna Sectors

- Each sector consists of plurality of "patches" may be tilted along L1 and/or L2
- Ground and dielectric planes are not shown





2620-H

Move in the θ - Direction Signal

2620-V

Move in the ϕ Direction Signal

Moveable Direction:
Motion Control Signal in Two Circular Coordinates: v(θ,ϕ)

Fig. 27

Plurality of Vertically Stackable Tube-like/Yagi Antenna Sectors

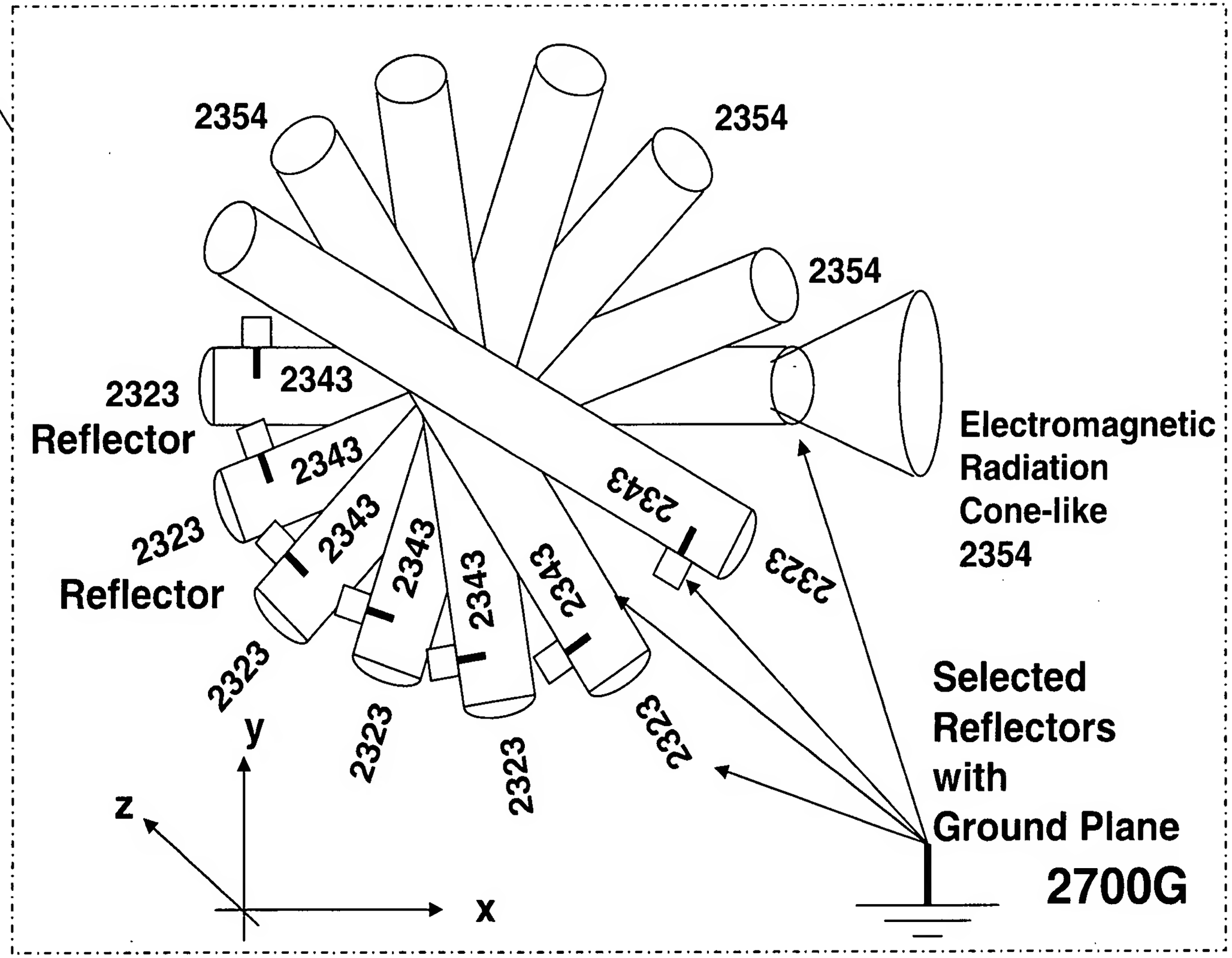
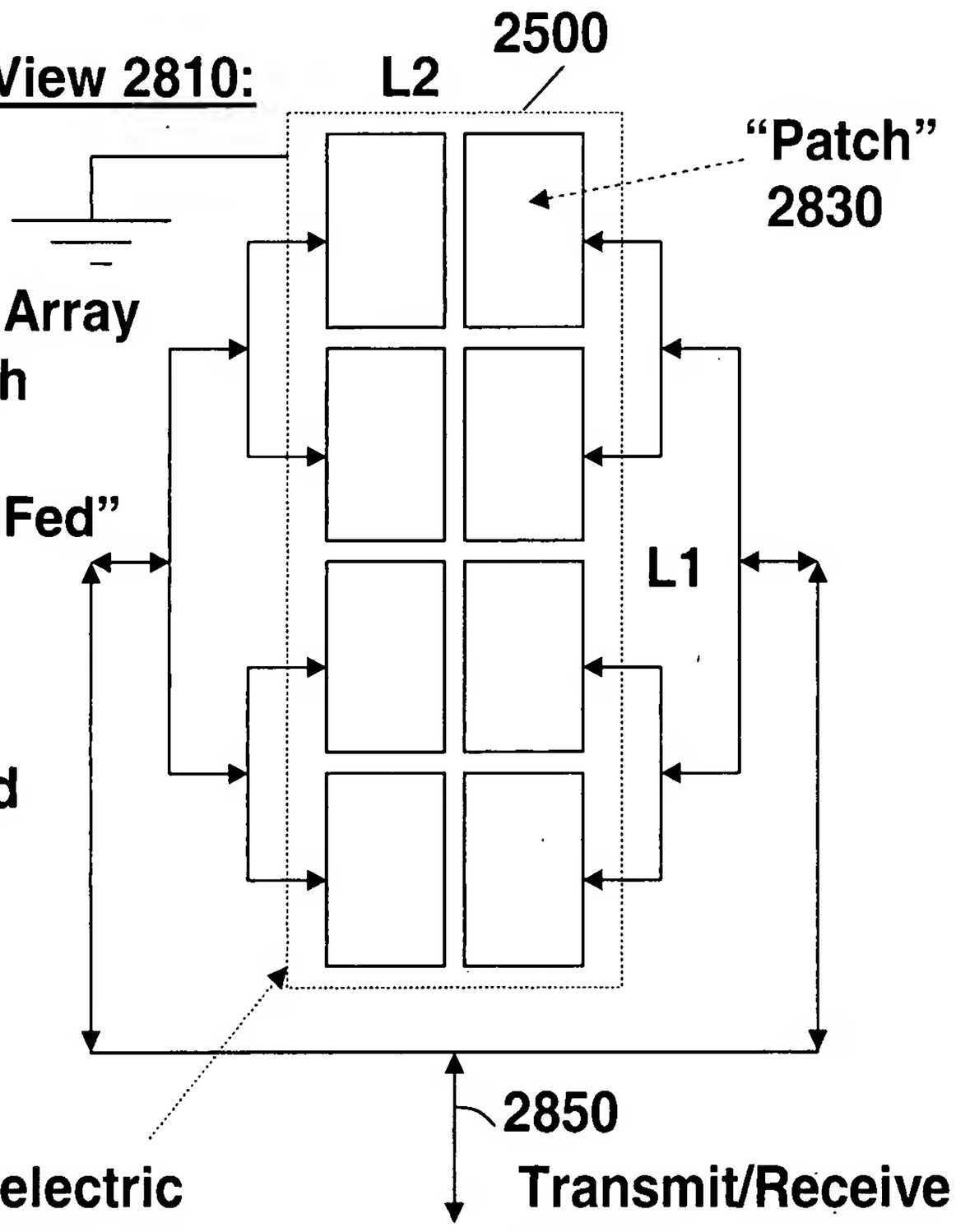


Fig. 28

Flat Panel Antenna Sector

Front View 2810:

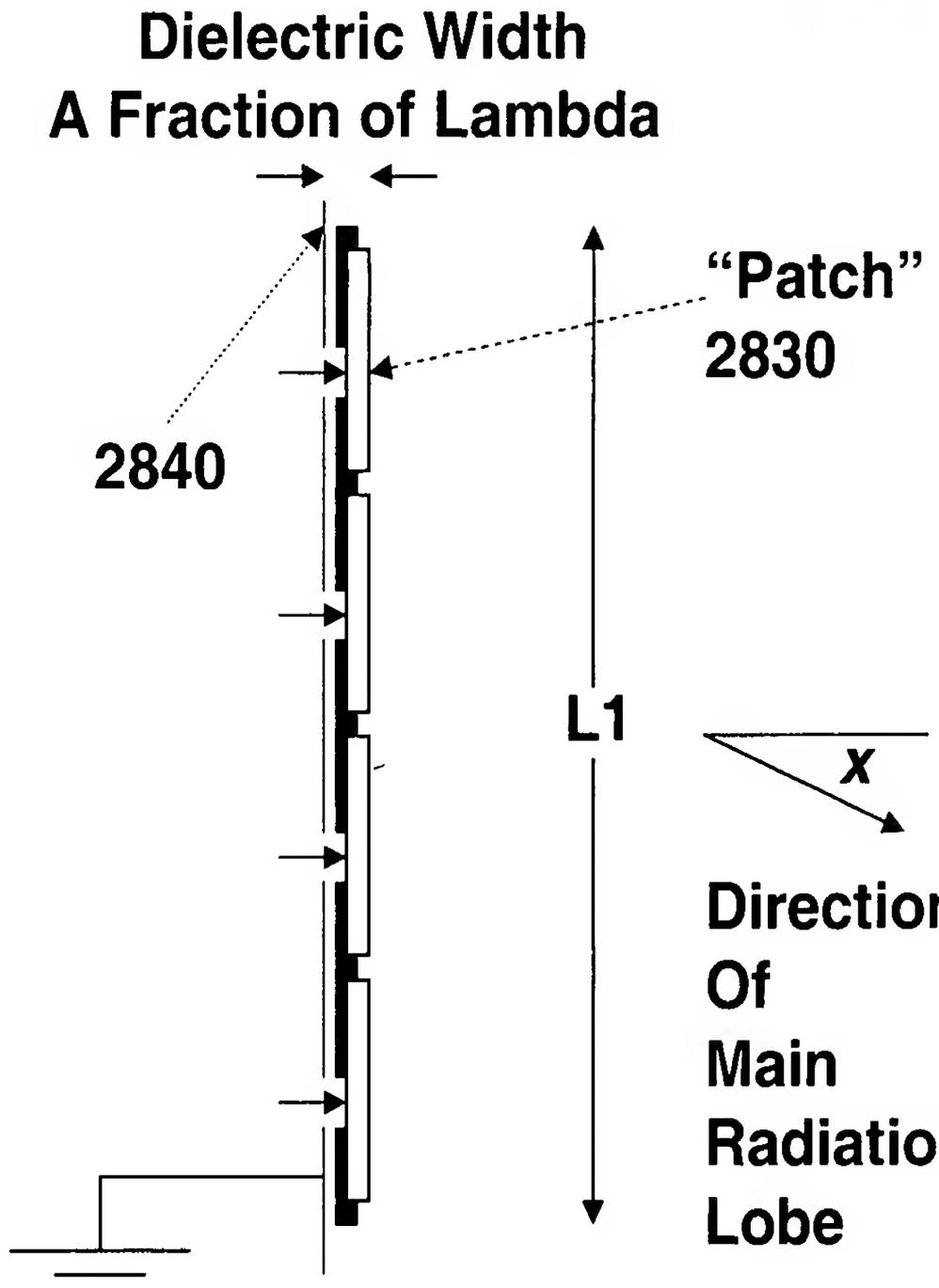


2500
Static Phase Array
Structure with
Plurality of
"Patches" - "Fed"
with Phase
Shift Signals
via Wires
Of Predefined
Lengths

2840
Predefined Dielectric
Material and Ground
(with a Fraction of Lamnbda
Margins Around the Patches)

2850
Transmit/Receive
Signal

Side View 2820:



Direction
Of
Main
Radiation
Lobe

Aperture ≈ L1*L2*cos(*x*)

Fig. 29

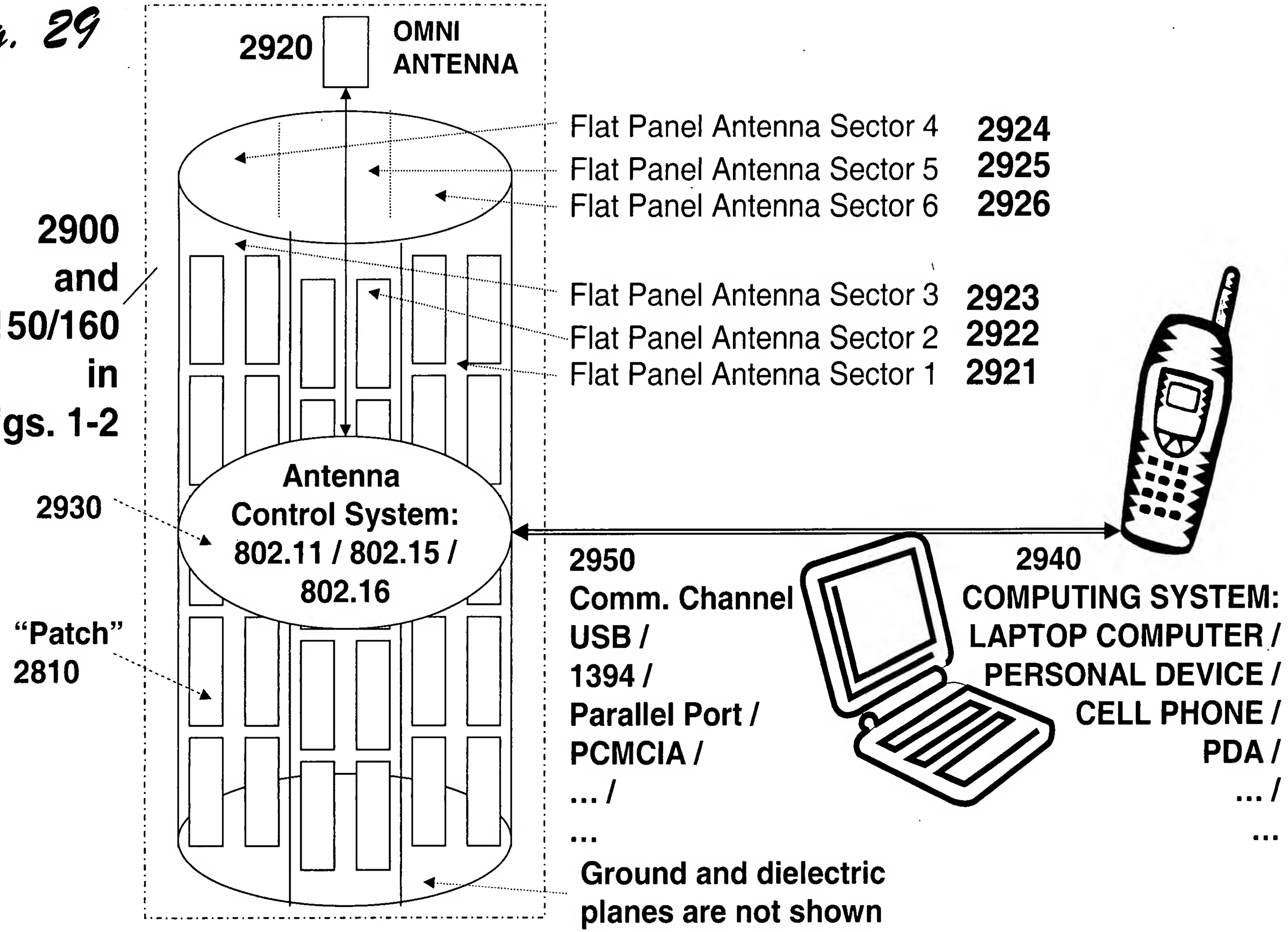

2920
OMNI ANTENNA
Flat Panel Antenna Sector 4 2924
Flat Panel Antenna Sector 5 2925
Flat Panel Antenna Sector 6 2926
Flat Panel Antenna Sector 3 2923
Flat Panel Antenna Sector 2 2922
Flat Panel Antenna Sector 1 2921
2900 and 150/160 in Figs. 1-2
Antenna Control System: 802.11 / 802.15 / 802.16
2930
"Patch" 2810
2950 Comm. Channel USB / 1394 / Parallel Port / PCMCIA / ... / ...
2940 COMPUTING SYSTEM: LAPTOP COMPUTER / PERSONAL DEVICE / CELL PHONE / PDA / ... / ...
Ground and dielectric planes are not shown

Fig. 30

Plurality of Flat Panel Antenna Sectors Radiating Electromagnetic Signals in Predefined Direction in Space – Selected Panels can be Tilted

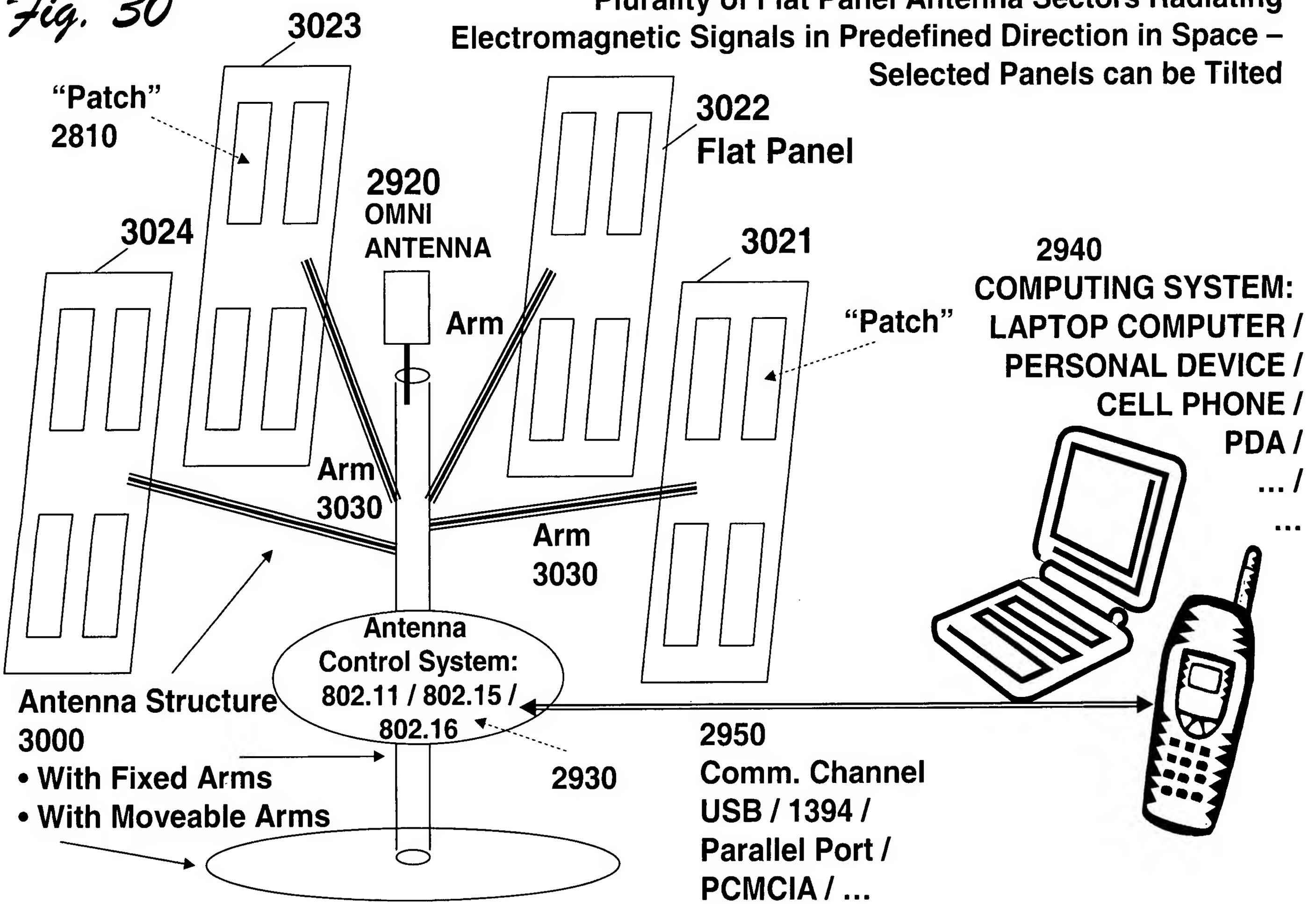
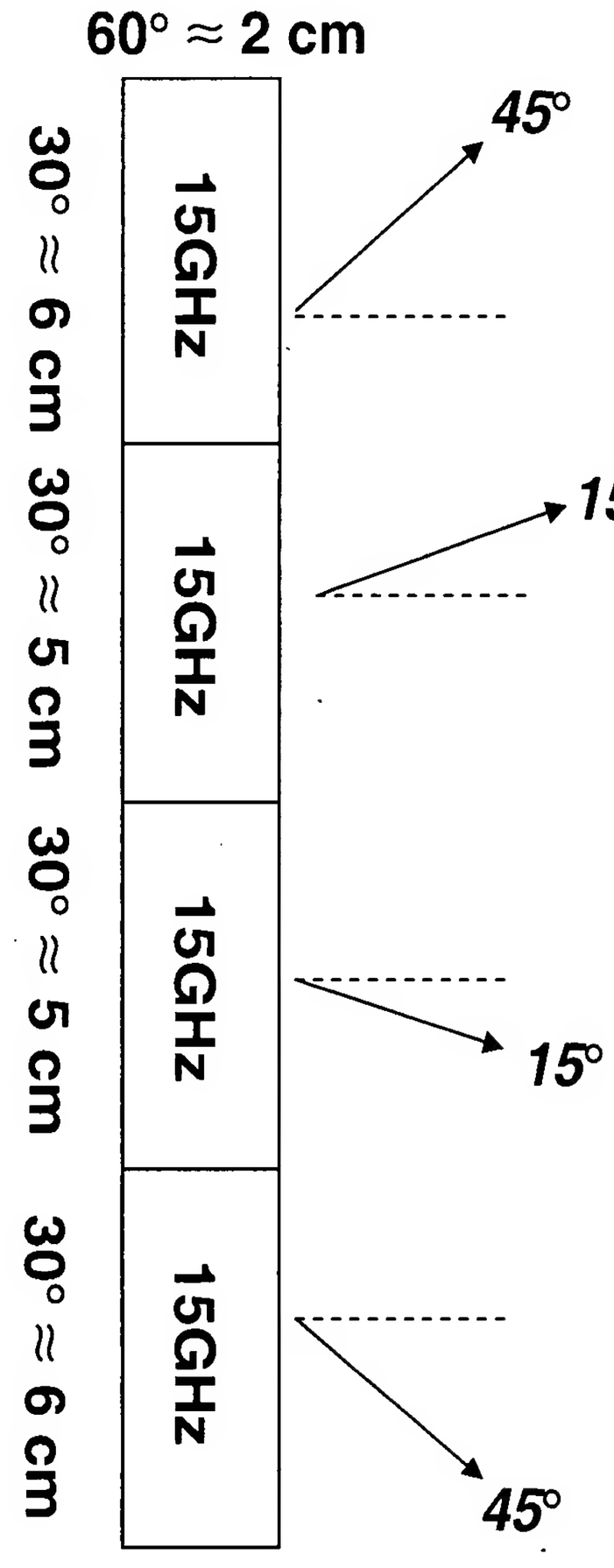


Fig. 31

A Vertical Slice of Cylindrical Shape Structure
(6 Vertical Slices with Hexagonal Arrangement for Covering 360°)



Vertically Stackable For Quadruple Spatial Coverage

Direction Of Main Radiation Lobe (3db)